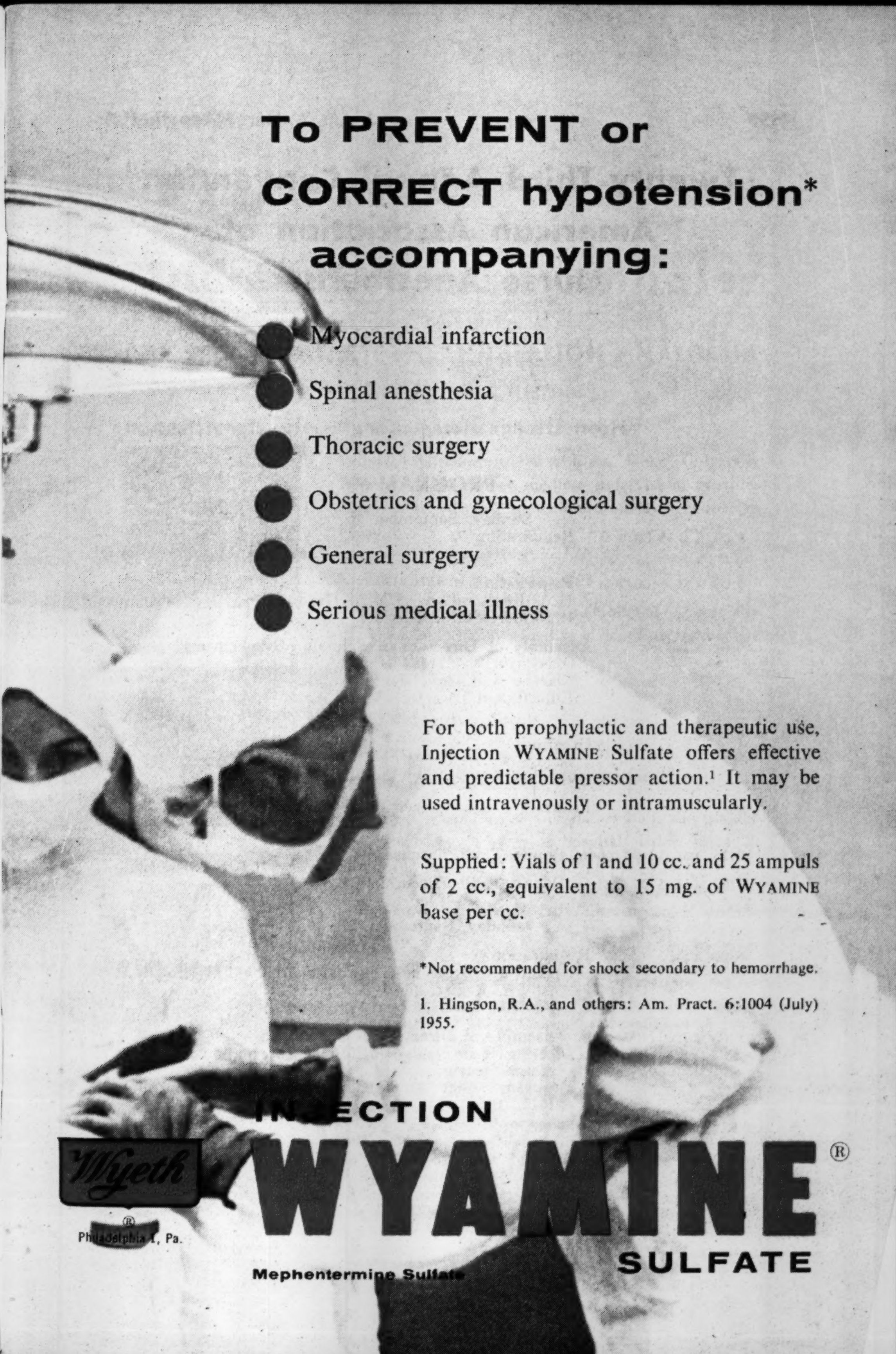
Journal

IN THIS ISSUE

The Journal of the American Association of Nurse Anesthetists is published quarterly by the American Association of Nurse Anesthetists, 116 S. Michigan Ave., Chicago 3, Ill. Entered as second class matter, May 14, 1945, at the post office at Chicago, Ill., under the act of March 3, 1879. Address all communications relative to editorial and advertising matters to the Editor, 116 S. Michigan Ave., Chicago 3, Ill. Subscription prices: to members, 50c a pear; to nonmembers and institutions $1.50 a year; single copies, 50c. The opinions expressed in the columns of the Journal are those of the contributors and are not to be construed as reflecting the views of the American Association of Nurse Anesthetists.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1. Hingson, R.A., and others: Am. Pract. 6:1004 (July) 1955.
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Twenty-Third Annual Convention American Association of Nurse Anesthetists

September 17-20, 1956

CHICAGO, ILLINOIS

Hotel Headquarters — Congress Hotel

PROGRAM

Sunday, September 16

8:00 A.M.-5:00 P.M.—**Registration**
A.A.N.A. Registration—Foyer, Glass Hat, Congress Hotel

9:00 A.M.-5:00 P.M.—**Registration**
A.H.A. Registration—A.H.A. Headquarters, Palmer House, 4th Floor, South Corridor

9:00 A.M. **Assembly of Directors of Schools of Anesthesia***
Glass Hat, Congress Hotel
Clarene A. Carmichael, R.N., B.S.
Educational Director, A.A.N.A.
Presiding Officer

Greetings
Minnie V. Haas
President, A.A.N.A.

Program under supervision of Clarene A. Carmichael, R.N., B.S.

9:15 A.M.-12:00 noon **Round Table Discussions**

2:00 A.M.-5:00 P.M. **Round Table Discussions**

Monday, September 17

8:00 A.M. **Registration**
A.H.A. Registration—International Amphitheatre
A.A.N.A. Registration—A.A.N.A. Exhibit Booth No. 797, International Amphitheatre

9:00 A.M.-12:00 noon **Assembly of Directors of Schools of Anesthesia***
Meeting Room end of aisle 600, International Amphitheatre
Program under supervision of Clarene A. Carmichael, R.N., B.S.

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*Although this program is of specific interest to Directors of Schools of Anesthesia, ALL members are invited to attend these sessions.

2:00 P.M.

General Session

Meeting Room end of aisle 600, International Amphitheatre
Minnie V. Haas, R.N.
President, A.A.N.A.
Presiding Officer

Invocation
Mrs. Florence M. Doolin, R.N.
Pontiac, Michigan

Address of Welcome from A.H.A.
Edwin L. Crosby, M.D.
Director
American Hospital Association

Address of Welcome
Minnie V. Haas, R.N.
President, A.A.N.A.

2:15 P.M.

Mrs. Irene Hoge, R.N.
President, Carolinas-Virginias Assembly of Nurse Anesthetists
Presiding Officer

The American Association of Nurse Anesthetists and Hospitals
Frank R. Bradley, M.D.,
Director
Barnes Hospital
St. Louis, Mo.

Role of the Nurse Anesthetist in the Relief of Pain
John S. Lundy, M.D.
Senior Consultant, Section of Anesthesiology
Mayo Clinic
Rochester, Minn.

You, Your Associations and the Law
Emanuel Hayt
Counsel
A.A.N.A.
New York, N. Y.

7:00 P.M.

State Night Dinner
Gold Room, Congress Hotel
Mrs. Opal Schram, R.N.
Chairman, Convention Committee
Presiding Officer

Tuesday, September 18

9:00 A.M.

Business Session
Meeting Room, end of aisle 600, International Amphitheatre
Minnie V. Haas, R.N.
President, A.A.N.A.
Presiding Officer

Call to Order
Appointment of Tellers
Roll Call

Report of Approval of Minutes Committee
Reports of Officers
Reports of Standing Committees

11:00 A.M.-1:00 P.M.—**Election of Officers**

2:00 P.M. **Business Session**
Meeting Room end of aisle 600, International Amphitheatre
Minnie V. Haas, R.N.
President, A.A.N.A.
Presiding Officer

Reports of Standing Committees
Reports of Special Committees
Unfinished Business
New Business

4:30 P.M.-6:30 P.M. **Silver Anniversary Tea**
Hostesses Assemblies of Nurses Anesthetists

Wednesday, September 19

9:00 A.M.-12.00 noon **Council Session***
Meeting room end of aisle 600, International Amphitheatre
Florence A. McQuillen, R.N.
Executive Director, A.A.N.A.
Presiding Officer

2:00 P.M. **General Session**
Meeting room end of aisle 600, International Amphitheatre
Mary Frances Smith, R.N.
Chairman, Southeastern Assembly of Nurse Anesthetists
Presiding Officer

Infant Salvage
Lloyd H. Mousel, M.D.
Director, Department of Anesthesia
Swedish Hospital
Seattle, Wash.

Relationship Between the Surgeon and the Anesthetist
Loyal Davis, M.D.
Chairman, Department of Surgery
Northwestern University Medical School

The Give and Take in Anesthesia
John Adriani, M.D.
Director of Anesthesia
Charity Hospital
New Orleans, La.

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*Although the Council, as provided by the By-Laws of the A.A.N.A., consists of officers and standing committees of national and state associations, the Council session is open to all members and restricted to members of the A.A.N.A.

7:30 P.M. **Banquet**
Gold Room, Congress Hotel
Minnie V. Haas, R.N.
President, A.A.N.A.
Presiding Officer

Invocation
Reverend Kenneth Hildrebrand
The Central Church of Chicago
Chicago, Ill.

Presentation of Awards

Thursday, September 20

9:00 A.M. **General Session**
Meeting Room end of aisle 600, International Amphitheatre
Marian Magdich, R.N.
Chairman, New England Assembly of Nurse Anesthetists
Presiding Officer

Changes in the Acid-Base Balance Which Develop After Short Periods of Anesthesia
James A. Helmsworth, M.D.
Assistant Professor of Surgery
Cincinnati General Hospital
Cincinnati, O.

The Geriatric Patient and Anesthesia
Richard H. Barrett, M.D.
Director of Section on Anesthesiology
Hitchcock Clinic
Hanover, N. H.

Clinical Experiences with Muscle Relaxants
Mary Karp, M.D.
Director, Department of Anesthesia
Chicago Wesley Memorial Hospital
Chicago, Ill.

2:00 P.M. **General Session**
Meeting room end of aisle 600, International Amphitheatre
Jennie Cross
Chairman, Upper Midwest Assembly of Nurse Anesthetists
Presiding Officer

Obstetric Anesthesia—Some Prejudices and Conclusions
Harold A. Ott, M.D.
Clinical Assistant Professor of Obstetrics and Gynecology
Wayne University College of Medicine
Detroit, Mich.

Danger Ahead
Evelyn Auld, R.N.
Director, School of Anesthesia
Watts Hospital
Durham, N. C.

4:00 P.M. —**Unfinished Business**

4:15 P.M. —**Adjournment of General Session**

Call to the Convention

As provided for in the Bylaws of this Association, and at the direction of Miss Minnie V. Haas, President, we hereby issue this official call to the members for the annual meeting to be held in Chicago, September 17-20, 1956. The annual business session will be held on Tuesday, September 18, in the International Amphitheatre.

Accomplished at the Executive Office, 116 South Michigan Avenue, Chicago 3, Illinois, this first day of July, 1956.

FLORENCE A. MCQUILLEN, R.N.
Executive Director

Adrenal Cortical Insufficiency a Problem for the Anesthetist

Donald W. Maas, M.D. *
Dallas, Texas

Few practicing anesthetists can look back over their cases and honestly say that none of their patients ever developed a profound and persistent hypotension with no apparent or obvious cause. And, should such patients not respond to the usual regimes of shock therapy, one must suspect and consider adrenal cortical insufficiency as a possible etiological factor.

There is no doubt a multiplicity of determining factors in all cases of shock. There might be a combination of initiating factors such as psychogenic, pain, loss of circulating blood or plasma volume, too deep planes of anesthesia, reflex phenomenon, reduced cardiac output or frank cardiac failure, surgical trauma, patient position, ganglionic blocking agents, etc.

The adrenal theory of traumatic shock[10] has been considered along with many others for years. Douglas,[5] in 1923, considered the use of adrenalin from the adrenal medulla as a rational treatment for burns. He based this on the work of Bardeen[3] who, in 1897, showed definite degenerative changes in the adrenal glands of patients who died of burns.

Today, with the more recent identification and study of the hormones excreted by the adrenal cortex, coupled with an understanding of the adaptation syndrome advanced by Hans Selye,[13] a workable, understandable theory of bodily response to all stress factors is at last available. It is the purpose of this paper to formulate a practical, simplified understanding of the mechanisms involved between the hypothalamic—pituitary—adrenal axis in its response to bodily stress.

First, let us consider what constitutes stress. Almost any stimulus whether it be pain, cold, heat, trauma, hypoxia, hypercapnia, anesthesia, surgery, even mental anguish will produce an hormonal response with resultant changes in bodily chemistry and function. Recently it has been shown that the amount of stress during anesthesia is directly proportional to the depth of anesthesia, all of which has caused many of us to ponder if it is not better for the patient to have light planes of anesthesia in combination with relaxant drugs rather than to depend upon deep planes of anesthesia for the required amount of muscular relaxation.

Studies by Selye[13] show that many stress situations will cause an "alarm" reaction, in which the adrenal medulla participates, and which

*Chief, Anesthesiology Section, Veterans Administration Hospital, Dallas, Texas.
Presented at the 20th annual meeting of the Texas Association of Nurse Anesthetists, Dallas, Texas, April 3, 1956.

is followed by adrenal cortex response. You remember the old physiological adage that the adrenal gland, through its sudden liberation of adrenalin following severe stress, helped to prepare the individual for either fight or flight. To put it another way, the adrenal medulla produces a substance (adrenalin) capable of immediate mobilization of resources for meeting a stressful situation, whereas the adrenal cortex stimulates the provision of greater resources for more prolonged and future stresses.

The adrenal glands are small, paired organs lying just cephalad to the kidneys. Their cortex is capable of producing a variety of compounds known as steroids, some 28 of which have been identified. The functional activity of the adrenal corticies is regulated by the anterior pituitary gland through its secretion of adrenocorticotrophic hormone (ACTH). Both the adrenal and pituitary function is also regulated by the hypothalamus of the mid-brain.[14] Thus, disturbances of adrenal function may be of adrenal, pituitary or hypothalamic origin.

The steroid hormones secreted by the cortex of the adrenal glands may be put into three general groups:[4,14,15]

Glucocorticoids or sugar hormones. These are related to cortisone and Kendall's compound F and exert a profound action on the carbohydrate metabolism of our bodies as is exemplified by their powers of glucogenesis and findings of hyperglycemia and glycosuria. And, although the blood sugar is increased, it is also rendered more resistant to insulin. No wonder, even before we had any knowledge of the glucocorticoids, we always worried about the diabetic patient during anesthesia and postoperatively. But now we know that this same sugar problem can trouble even the non-diabetic who is given or is excreting an excess of glucocorticoids. Interesting enough, they are also capable of producing a sudden fall in the patient's peripherally circulating eosinophiles.[2,6,7,15] In addition, but to a lesser degree, they increase the loss of nitrogen from the body in the urine, putting the patient in a negative nitrogen balance; produce an increased loss of intracellular potassium and cause a retention of sodium and chlorides. The latter, of course, encourages increased amounts of water to become trapped in the intercellular spaces and to escape from the circulating blood volume.

Mineral corticoids. These are related to desoxycorticosterone or Reichstein's compound S. These steroids exert their most profound influence on the renal retention of sodium and chloride, thus holding back water. Potassium, however, is caused to be excreted in large amounts as with the glucocorticoids.

Sex hormones. The third group is essentially composed of sex hormones—these are important, but do not concern us with this particular subject.

There are some known types of chronic and acute forms of adrenal cortical insufficiency which have been described and known as disease entities for many years. Instead of stress being the etiological factor of the cortical exhaustion, however, disease of the adrenal gland including its cortex produced a similar metabolic disturbance. For example, Addison's disease is a syndrome of adrenal cortical insufficiency[14] most cases of which are due to a tuberculous destruction of the adrenal cortex. The

Waterhouse-Friderichsen syndrome (meningococcic septicemia) is an example of acute adrenal cortical insufficiency which results from multiple, small hemorrhagic areas within the adrenal cortex.

Let us consider general groups or types of patients who may be considered likely to have insufficient adrenal cortical function to withstand the stress of anesthesia and surgery[8]——

1. **Those patients undergoing extensive surgical procedures.** Severe and prolonged operations have shown a prolonged fall in serum sodium and chlorides which changes are less marked in less severe surgical procedures. It may be concluded that undue operative stress may exhaust the adrenal glands to a point where they can no longer secrete the hormones which attempt to protect and keep a body in a condition of status quo.

2. **Psychotic patients** (especially schizophrenics with their continually disturbing conflicts of reality vs. hallucinations and dream world states). A 72% hyporesponsitivity to stress has been reported in groups of schizophrenics. The method used for testing was the increased salt excretion found in their perspiration as compared to normal.

3. **Senile patients** (especially those with chronic debilitating diseases). We know that the 17 ketosteroid output decreases with age, and these patients adapt poorly to chronic stress of any kind. When an acute and severe stressful situation is superimposed, their adrenal cortical function is not sufficient to cope with it.

4. **Patients with certain urological disorders:** (a) accidental removal of, or trauma to an adrenal during nephrectomy, is often unavoidable, thus putting undue strain and protective responsibility on the remaining adrenal gland; (b) cancer of the prostate sometimes metastasizes to the adrenal glands, almost totally replacing their normal tissue; (c) atrophy of the opposite adrenal in cases of adrenal tumor. In general, it might be said that many of the urological patients without any of the aforementioned conditions are candidates for adrenal cortical insufficiency because of their high incidence of cardiac disease, salt free diets with resulting hyponatremia, advanced age, and then the additional stress of anesthesia and surgery.

Probably the most important group of patients we are beginning to see in increasing numbers are those who have been, or are being treated with cortisone, hydrocortisone, metacortin, ACTH, or any of the other allied steroids of the adrenal cortex.[9] With the exception of the pituitary ACTH, the other hormones only serve to decrease the function of the adrenals. Indeed, severe atrophy of these glands may result,[12] and the administration of ACTH may alter pituitary function to a point of causing the impairment of endogenous ACTH production once the drug is removed. Thus, both ACTH and adrenal cortical hormones produce similar peripheral, findings, however, the principal difference between them is that the former stimulates and the latter inhibits adrenal cortical function.[3] The question always arises: How long a time after a patient is taken off such therapy before either his adrenal or pituitary function will return to normal and we may consider it safe for him to withstand anesthesia and surgery? Literature varies regarding the answer, but the more conservative groups feel that at least 18 months[12] should follow cessation of therapy

before assuming that adequate adrenal cortical function has returned. Nevertheless, any patient who has had prior treatment with these hormones should be carefully watched and treated promptly if signs of adrenal cortical insufficiency develop during or after operation. Postoperative signs will almost always develop within the first 24 hours. Signs[8,14] which would indicate such a development include—

1. **Unconscious patient:**
   (a) Marked and persistent hypotension which is refractive to its usual treatment
   (b) Increased pulse rate
2. **Conscious patient** may exhibit in addition to the above:
   (a) Profound asthenia
   (b) Clammy pallor
   (c) Profuse diaphoresis
   (d) Vomiting and/or diarrhea
3. **Laboratory findings** which might be expected in either case:
   (a) Low blood serum sodium and chloride
   (b) Low CO_2 combining power
   (c) Increase of serum potassium
   (d) Increase of blood urea
   (e) Increase of NPN

Case Report

The following is a typical case report as reported by Paulshock:[11] "The patient, a 37 year old white female, has suffered chronic rheumatoid arthritis for 20 years. The arthritic process is generalized, involving bilaterally her elbows, wrists, hands, knees, hips, and tempero-mandibular joints. On October 20, 1953, she was admitted to the hospital for arthroplasty of her right knee which had been fixed in flexion for two years.

"Her family history is of interest in that her mother and a maternal aunt also had rheumatoid arthritis of comparable severity. The patient's 16 year old son has had two bouts of rheumatic fever.

"For the past three years she has been receiving oral cortisone in a dosage of 50 mg. to 100 mg. per day. After one year of cortisone therapy, the patient noticed that her face had assumed a rounder contour.

"In December, 1952, an uneventful cholecystectomy for chronic calculous cholecystitis was performed. Preceding this operation her maintenance dosage of cortisone, 75 mg. per day, was continued, as well as 20 mg. per day of D.O.C.A. These medications were resumed the first postoperative day.

"In June, 1953, she had another uneventful hospitalization during which arthroplasty of her left elbow was performed. Prior to surgery her maintenance dosage of 100 mg. of cortisone was continued and it was resumed immediately postoperatively.

"Before this present admission on October 20, she was taking 100 mg. of cortisone daily. None was administered to her during the three days preceding her operation on October 23. The operative procedure was performed under ether-cyclopropane-nitrous oxide anesthesia of 90 minutes duration. No intravenous fluids were administered during the surgery. Her pulse rate was 60 per minute at the beginning and 70 per minute at the end of the surgical procedure; blood pressure was not recorded during surgery but on return to the ward the nurses' notes report a blood pressure of 100/70 with a pulse rate of 72.

"During the first postoperative night the nursing staff was unable to obtain the patient's blood pressure or radial pulse and she began to vomit and sweat profusely. Her skin was

cold and clammy and her pulse rate was 138. Her vomiting and hypotensive state continued and a medical consultation was requested. Approximately twelve hours after the hypotensive state was first noted therapy for adrenal insufficiency was instituted; 300 mg. of cortisone were given by mouth and 100 mg. intramuscularly. At the same time 20cc. of aqueous adrenal cortical extract were administered intramuscularly. The intravenous route would have been preferred but no veins were available and at that time is was decided to defer venous cutdown unless no response was obtained to the oral and intramuscular medications. At this time a few beats were auscultable with a sphygmomanometer at 70mm. and her apical pulse rate was 140. By catheterization one and one-half hours later 90 cc. of urine were obtained. A Foley catheter was left indwelling and urine output measured half-hourly. For the next three hours, urinary output averaged 15 cc. per hour and the patient's cold, clammy state persisted. Her pulse rate increased to a high of 176 per minute. Throughout this time she remained conscious and alert but complaining of cold and nausea.

"Eight hours after the administration of the oral cortisone a venous cutdown was performed and 1,000 cc. of 10 per cent invert sugar in 0.9 per cent sodium chloride was administered. To the infusion were added 40 mg. of ACTH and 20 cc. of adrenal cortical extract. During the next two and one-half hours her half-hourly urine output totaled 5 cc., 40 cc., 70 cc., 120 cc., and 150 cc. Her blood pressure one hour after the intravenous infusion was begun was 97/70. In two hours it was 110/80. By three hours it had increased to 140/80 and has remained at that level. Her tachycardia decreased gradually during the next 48 hours. Cortisone administered by mouth was continued at eight hour intervals with a total dosage of 475 mg. the first day, 225 mg. the second day, and 150 mg. the third day, with a more gradual decrease to 57½ mg. daily. For the first three days a 10 hour infusion— of ACTH was given in addition to the cortisone by mouth."

From a practical standpoint, what should we do and not do if adrenocortical insufficiency is suspected?[1] Many of the "do's" and "don'ts" are similar or the same as one might list for the conduct of any good anesthesia, but let us review them in the light of the aforegoing discussion:

DO'S

Light preoperative medication

Light planes of anesthesia

Realize these patients are extremely relaxed even in light anesthesia

Maintain adequate exchange and oxygenation

Make sure CO_2 is being eliminated

Use anesthetic agents and procedures which will not cause BP to fall

Establish rapport and confidence in patient

Use rapidly eliminated drugs for anesthesia, especially cyclopropane

Have available: hormones, vasopressors, and blood volume expanders

DONT'S

Patients are very sensitive to hypnotic drugs—do not oversedate

Patients are sensitive to anesthetic drugs—do not use deep planes

Deep planes mean greater stress. Avoid the use of muscle relaxants

Hypoxia is a severe stress and poorly tolerated

Hypercarbia is a severe stress and is poorly tolerated

Avoid spinal anesthesia, avertin and barbiturates

Avoid fear or fright

Don't allow blood loss or excessive trauma

Avoid ether

Don't be unprepared—adrenocortical insufficiency may be subclinical and unsuspected and precipitate in any of the group of patients we have considered

Conclusions

In conclusion, let us remember that adrenal cortical hormones and the adrenocorticotrophic hormone are not to be considered as routine treatment for shock, but as specific and life saving and rational treatment for the patient in shock resulting from adrenal cortical insufficiency.

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Direct Vision Open Cardiac Surgery and Anesthesia

Olive L. Berger, R.N. *
Baltimore, Maryland

Techniques for the direct vision repair of intracardiac defects are developing so rapidly it seems appropriate to review the subject briefly.

Ten years have passed since the first successful operation for tetralogy of Fallot. This operation has not only given hope and new life to thousands of incapacitated patients, but it has also stimulated many investigators to perfect procedures for the performance of intracardiac surgery under direct vision.

Surgeons have felt for a long time that direct vision intracardiac surgery is entirely feasible. Alexis Carrel[1] in 1914, reported successful surgery of this type on dogs. Such operations are being performed on humans, with promising results in many clinics today. The fact that a growing number of these operations have been successful clearly establishes their feasibility, but the associated high mortality demonstrates that the problem has not yet been solved.

The great progress made in the past five years in this field has stemmed from the ingenious applications of both old and new techniques of surgery and anesthesia for the maintenance of vital functions during that period when the heart is open.

*Johns Hopkins Hospital, Baltimore, Md.
Read before the 20th annual convention of the Ohio State Association of Nurse Anesthetists, Columbus, Ohio, April 10, 1956.

Methods

Techniques which have actually found clinical application fall into five major categories[2]——

(1) *The mechanical heart-lung apparatus.* This apparatus, pioneered by Dr. John Gibbon[3] acts as a substitute for the pumping action of the heart and oxygenating function of the lungs. Kirklin and associates[4,5] have adapted the Gibbon apparatus for use in some 93 humans; Lillehei has employed a similar method in 56 cases[6].

(2) *The donor cross-circulation system.* By this method a human donor's heart substitutes for that of the patient.

(3) *The mechanical heart-animal lung method.* Here the animal lungs are employed to provide the blood gas exchange while a mechanical pump acts as the heart.

(4) *The heart-brain perfusion technique.* By this technique pre-oxygenated blood is pumped from a reservoir to the heart and brain only.

(5) *Hypothermia.* This method applies the principle of prolonged survival in the absence of the circulation by virtue of decreasing tissue oxygen requirements at lowered body temperatures.

There are many problems associated with the mechanical heart-lung machine: (a) there must be a suitable pump for removing the blood and returning it to the patient in as efficient manner as the heart; (b) provision must be made for blood gas exchange: In the Gibbon apparatus this has been accomplished by passing the blood over both sides of vertical mesh screens which are suspended in plastic containers; here the blood takes up oxygen and gives off carbon dioxide; (other types of oxygenators have been and are being devised); (c) constant blood volumes at any rate of flow must be maintained; (d) all the blood returning through the veins to the heart must be removed smoothly without collapsing them; (e) provision must be made for the disposal of blood returning from the chambers of the heart and from the coronary arteries.

The advantages of the heart-lung machine are: (1) the entire body is perfused; (2) hypothermia is not necessary; and, (3) the period the heart may be open is prolonged.

The disadvantages are: (1) red

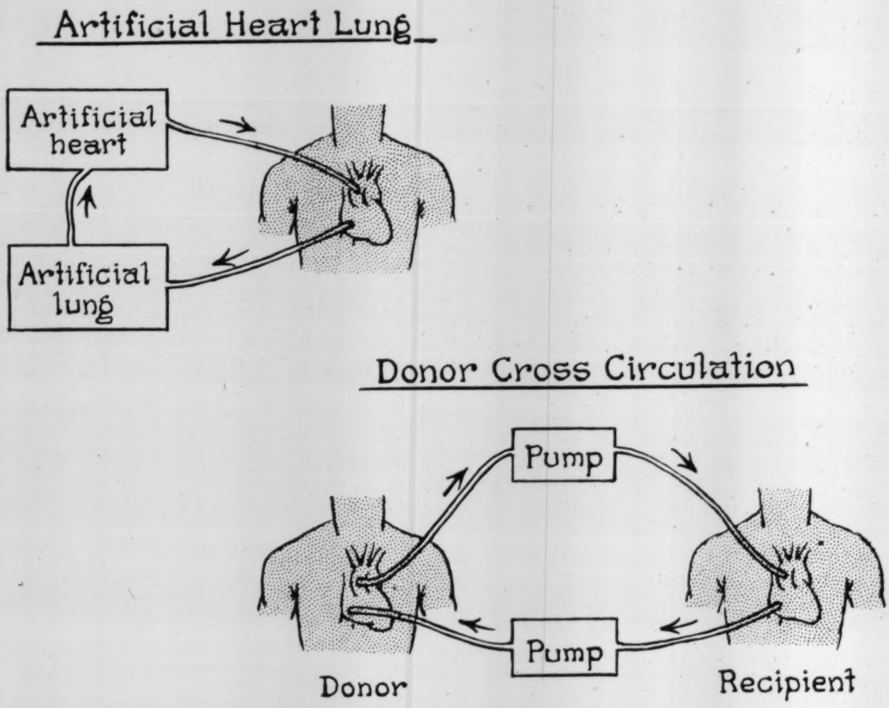

Fig. 1

In the artificial heart-lung apparatus a mechanical heart furnishes the pumping action for the circulation and an artificial lung device provides for blood gas exchange.

In the donor cross-circulation system venous blood from the patient's azygos vein passes into the venous system of the donor through an external pump. Oxygenated blood passes from the donor's arterial system through a pump into the aorta of the patient. The pumps are utilized to balance blood volume between the patient and donor.

cells are injured or broken; (2) platlets and fibrinogen are removed; (3) air bubbles in the form of foam may be introduced as dangerous emboli; (4) anticoagulants are necessary to prevent clotting with an inherent risk to the patient, namely postoperative hemorrhage; (5) there is an "X" factor which includes other unknown changes in the blood that may cause morbidity or death; both human and experimental experience has borne this out; (6) the patient is cooled unless the blood is kept warm.

These problems have largely been overcome by the Gibbon type apparatus but not to the complete satisfaction of all investigators. (Fig. 1) The search continues for the perfect apparatus of this kind.

Continuing the search for a less complicated and yet comparatively safe or safer method, other investigators, prime among them Lillehei and associates, developed the donor cross-circulation system[7].

This system transfers the arterial blood of the donor to the arterial circulation of the recipient, returning the recipient's venous blood to the venous system of the donor (Fig. 1). The father, mother or a close relative of the same blood type acts as donor. The donor's femoral artery is cannulated and connected to a cannula in the recipient's carotid artery. A cannula is introduced down the jugular vein to the recipient's superior and inferior vena cavae. By means of ligatures about the superior vena cava and inferior vena cava, blood returning to the heart of the patient is diverted to the donor. The donor's heart provides the driving force for the circulation of both the donor and recipient. To balance the blood volume between donor and patient two pumps are interposed between them ——inflow and outflow sides.

Lillehei and his associates at the University of Minnesota[8] have employed this system with considerable success. They have been able to repair intracardiac defects under direct vision in approximately 45 patients[6,8]. The open heart has been maintained for periods as long as thirty minutes.

Advantages of this system: (1) a large number of blood donors is not necessary; (2) the whole body is perfused; the rate of blood flow, however, is much less than with the heart-lung apparatus; the azygos principle is employed——this gives a flow of about one tenth of the normal cardiac output; the recipient's blood pressure is always low; (3) hypothermia is not necessary; and (4) it has been successfully applied clinically.

The disadvantages are: (1) the limited time factor; (2) the risk to the donor; and (3) the sociological and ethical problems involved.

In comparison to the heart-lung apparatus, this method is relatively simple. The risk to the donor is confined to "easily preventable complication such as blood incompatibility or air embolism due to faulty cannulations."[8] The sociological and ethical problems associated with this method have made some investigators hesitant to employ it. The patient is usually a poor risk small child whose chances of survival, with or without surgery, are limited. The matter of subjecting a healthy breadwinner or homemaker to the "preventable complications" of the donor has been controversial. Investigators are agreed that a method which does not involve the use of another human would be more desirable.

Animal lungs, usually dog but occasionally monkey, are used for the

blood gas exchange. (Fig. 2) The animal is exsanguinated. The pulmonary artery and veins are cannulated and all blood washed from the lungs. The cannulae are then connected to the cannulated vena cavae and subclavian artery of the patient. By means of a roller type pump the venous blood of the patient is circulated through the animal lungs where the blood gas exchange takes place and is returned to the arterial system of the patient. Animal experiments have demonstrated this to be a feasible method. To date clinical application has not been as satisfactory as the laboratory experience. Lillehei has reported 14 operations employing this technique.[6]

The advantages of the mechanical heart—animal lung system are: (1) no second human is involved; (2) only a comparatively small amount of donor blood is required; (3) hypothermia is not necessary and (4) a prolonged period for direct vision surgery is possible.

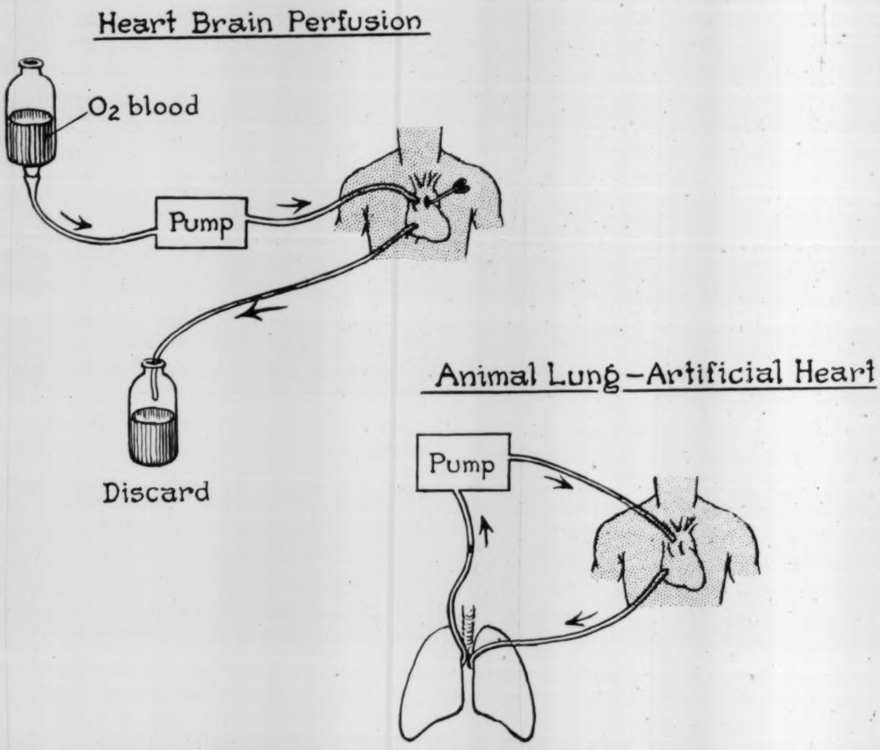

Fig. 2

In the heart-brain perfusion method arterialized blood is pumped from a reservoir to the aorta where it flows to the cerebral and coronary arteries. Venous return from the brain and coronary sinus is discarded.

In the animal lung-artificial heart technic the patient's venous blood flows by gravity at physiological pressures through the animal's lungs where blood gas exchange takes place. A mechanical pump returns the arterialized blood to the patient's aorta.

The disadvantages are: (1) the animal lungs may develop pulmonary edema if obstructions occur in the system or pumping pressures exceed physiological levels: it has now become rather uniformly established that some factor of incompatibility causes pulmonary edema when human blood is circulated through animal lungs; (2) the stigma of the use of an animal's lungs.

The fourth system, the heart-brain perfusion system developed by Kay and associates at the National Institutes of Health and The Johns Hopkins Hospital[9] has been applied clinically four times. (Fig. 2). In the dog, 17 to 20 animals have been shown to be chronic survivors. To date there has not been a successful human application.

A cannula is placed within the arch of the aorta of the patient through the subclavian artery. The aorta is clamped beyond the subclavian artery, thus eliminating systemic circulation except that to the heart and brain. A ligature is placed about the inferior vena cava to prevent, temporarily, the return of blood to the heart through this vessel. A cannula is placed in the superior vena cava to route the blood returning from the head to a disposal reservoir. The blood returning from the coronaries is removed by suction at the coronary sinus. A pressure of 100 mm. Hg is maintained in the aortic arch thus keeping the aortic valve closed throughout the perfusion and providing an adequate pressure in the coronary and cerebral arteries. The blood used for the perfusion of the heart and brain is drawn from several donors. It is oxygenated by the simple expediency of collecting it from the antecubital vein after the donor's entire arm has been immersed in a 45°C. bath for 10 to 15 minutes. The heat causes the venous blood to become arterialized to the range of 95 per cent oxygen saturation.[10] No additional oxygenation of donor perfusion blood is necessary.

The advantages of this method (in the laboratory) are: (1) it is simple; (2) there is no hemolysis, loss of platelets or fibrinogen; (3) postoperative bleeding is not a problem since there is a pool of patient's blood which has not entered into the perfusion; and (4) a rapid flow of blood at high perfusion pressures (over 100 mm. Hg) is maintained to the vital organs, the heart and the brain.

The disadvantages are: (1) the time limit of 8 to 12 minutes for open heart surgery where hypothermia is not employed; (2) hypothermia of at least 32° C. is required to prevent spinal cord and kidney damage if it is anticipated that repair of the defect may require more than 8 to 12 minutes; (3) a number of blood donors are required; and (4) only a part of the body is perfused.

While these methods have been undergoing investigation experimentally and clinically, the fifth method, hypothermia, has been successfully employed when the defect could be repaired in 8 to 12 minutes. Hypothermia is now widely used, not only for cardiac surgery, but for a variety of surgical procedures——notably for the poor risk patient. Scientific publications have reported the vast amount of research that has been done, and is being done, on this method. It will not be discussed here other than to emphasize that while it has proven to be very beneficial in selected cases, there are many physiological and metabolic problems associated with it that have not yet

been solved. The principal shortcoming has been the high incidence of ventricular fibrillation at temperatures below 30° C.——especially in cardiac surgery.

Experience with the above five methods in this country is beginning to indicate that the most acceptable method is the artificial heart-lung machine for total body perfusion. The type of pump, or oxygenator, may vary from surgeon to surgeon, but the principle remains the same. Kirklin and Lillehei are currently employing this type of apparatus.[6]

Clinical Indications

Cardiac surgery until very recently has been confined to the vessels adjacent to the heart or to the blind repair of defects by digital palpation. There remain many defects that could be more efficiently repaired with reasonable hope of complete cure if the surgeon had time to work in the open heart and could see what he had to repair. The above methods have been developed to make such surgery a practical procedure. Among the defects which could probably be better repaired under direct vision are: (1) intraventricular septal defects; (2) intra-auricular septal defects of the low or ostium primum type; (3) stenosis or insufficiency of the mitral and aortic valves; (4) infundibular stenosis; and (5) anomalous venous return.

Simple atrial defects have been repaired successfully for several years by closed heart surgery and probably do not require direct vision with its additional risk.

Anesthesia

There is no apparent ideal anesthetic agent or technique for these cases. In general, the anesthesia is that which has proven satisfactory for all cardiac surgery in the past. Artusio[11] has shown that cardiac surgery can be accomplished with a high degree of safety under ether analgesia. If hypothermia is to be used it is important to obtain a sufficient depth of anesthesia in order to prevent shivering during the chilling period. There appears to be no contraindication to the use of Pentothal for the induction and intubation of the cardiac patient. Virtue[12] suggests that volatile agents might be preferable for the patient if hypothermia is to be established. Metabolism of these agents in the body is not necessary, therefore there would be less interference with metabolism. Lillehei[9] reports occurrence of metabolic acidosis during the cardiac bypass period. There are indications that this metabolic acidosis may be compensated for by increasing the donor's respiratory minute volume to reduce the alveolar carbon dioxide tension below the normal range. Our limited experience gives indication that there may be a problem in maintaining adequate narcosis if the perfusion period extends beyond thirty minutes. This period is now compensated for by increasing the depth of ether anesthesia just prior to the start of perfusion. These patients have remained unconscious but they have become "light" to the point of moving the head and opening the eyes.

Clinical Experience

We have employed (at Johns Hopkins Hospital) four of the five methods of direct vision or open heart surgery outlined in this report. Although a rather wide experience has been accumulated in the laboratory with the donor-cross-circulation method in dogs this procedure has never been carried out in this hospital on humans. Hypothermia has been com-

bined with the heart-brain perfusion technique and very recently it has been successfully employed alone for direct vision repair of an aortic stenosis in an adult and the closure of three atrial defects in a small child. The method with which we have met success with the heart open longer than five minutes, is the artificial heart-lung apparatus. A Sigmamotor was used for the mechanical heart and the DeWall bubble oxygenator for the artificial lung.

A lemon-sized myxoma, growing from the atrial septum, and presenting in the left atrium so as to produce a ball valve obstruction of the mitral valve, was removed under direct vision while the heart was open ten minutes. This 57 year old white woman had been explored for mitral stenosis one month earlier and the tumor palpated through the left atrial appendage. She was returned to surgery for a bilateral thoracotomy which was carried out under Pentothal and Sucostrin for the induction and intubation; cyclopropane - oxygen - ether for the maintenance. The circulation through the heart and lungs was by-passed and the myxoma successfully removed. This was accomplished in the face of rather severe heart failure.

A second successful open heart operation under cyclopropane-ether-oxygen anesthesia was performed in the case of a 5½ year old white child with an intraventricular septal defect with pulmonary hypertension. A year previously, this child had had an artificial pulmonary atrial stenosis created in an effort to reduce the pulmonary pressure and protect against vascular changes in the lungs. Following bilateral thoracotomy the approach was made through a right ventriculotomy. The heart and lungs were by-passed for twenty-nine minutes and the heart open for twenty-five minutes. An avalon sponge was used to close the septal defect.

Of special interest in these cases is the fact that the fall in body temperature which occurs with artificial circulation, was carefully avoided by the use of an electrically controlled water mattress.

A 49 year old, obese, white male was cooled with the electric blanket to a temperature of 33.2° C. At this point a direct vision repair of an aortic stenosis was performed while the heart was open for three minutes. The anesthetic for this patient was Pentothal 30 cc, nitrous-oxide and oxygen in a two to one liter flow, and Sucostrin intermittently to a total dose of 100 mg. Forty-five minutes after completion of surgery and while the temperature was only 34° C, he became fully conscious.

This same method was employed on a five year old white child under cyclopropane - oxygen - ether anesthesia. Three atrial septal defects were closed during an open heart period of four minutes. The temperature was lowered to 30.5° C. before opening the heart. Consciousness was not regained until the temperature had reached 36° C. The postoperative course of each of these patients was completely free of complications.

A Liston-Becker carbon dioxide analyser was employed to record the carbon dioxide levels. The adult required a respiratory assist rate of ten per minute while the child's rate had to be kept at five to six per minute to maintain a balance. There was no appreciable fall in body temperature during the open heart period since no circulatory by-pass had been employed in these two cases.

Conclusions

The encouraging results of present-day direct vision cardiac surgery proves such operations are practicable. There can be little doubt that the problems associated with this type of surgery will be solved in the near future.

It is interesting to note that Dr. Alexis Carrel reported, in 1914, the experimental occlusion of the heart pedicle. He was then able to open the heart chambers and repair valves under direct vision if the occlusion period did not exceed two and one-half to three minutes.[1] At that time he predicted surgeons would some day be repairing cardiac defects under direct vision. That day may be close at hand.

Summary

Five methods by which direct vision cardiac surgery is being performed are cited. Animal experiment as yet is more encouraging than clinical application. The perfect anesthesia for these cases is not completely established. The future is encouraging for the surgical repair of intracardiac defects under direct vision.

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Pediatric Anesthesia

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Anesthetists who have had limited experience in administering anesthesia to children are still proceeding on the theory that children are "just small adults," and that if an anesthetic agent is appropriate for an adult, it is also appropriate for a child. However, certain anatomical and physiological characteristics peculiar to the child must be recognized and, accordingly, the amount of anesthetic agent and the technique of administering it must be suitably altered. Otherwise, the mortality rate associated with pediatric anesthesia will be high.

Anatomical And Physiological Variations

Respiratory System. The anoxia which can accompany anesthesia is probably the greatest single cause of morbidity and mortality from anesthesia in children.[1] Therefore, variations between the respiratory system of the child and that of the adult are of the utmost importance to the anesthetist. These include——

Resilience of the Bony Part of the Thoracic Cage. The thoracic cage of the child is cartilaginous in contrast to that of the adult. Consequently, in the presense of even a slight obstruction of the airway of the child, the negative intrathoracic pressure caused by inspiration will retract the anterior chest wall instead of overcoming the obstruction and permitting satisfactory respiratory exchange. The bony, less resilient thoracic cage of an adult would permit the force of inspiration to overcome a similar obstruction more readily.

Incomplete Development of the Lung Tissue. The infant's respiratory epithelium is not as fully developed as that of the adult, which decreases the amount of pulmonary alveolar tissue available for aeration. This, coupled with the relatively large size of the trachea and bronchi, causes a relative increase in dead space, i.e., a smaller percentage of the oxygenated air (tidal volume) enters the small alveoli of the infant, and thus normal volumes of oxygen cannot be absorbed into the circulation. This is especially important in premature infants.

Increased Respiratory Rate. The normal respiratory rate of the infant is 30 to 40 times a minute and that of the child 20 to 30 times, in contrast to the adult's 15 to 20 times. Any factors which will increase this respiratory rate will contribute to rapid fatigue in the child, e.g., accumulation of CO_2, painful stimuli

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under light anesthesia, heat retention, etc. These conditions must be studiously avoided.

Small Tidal Volume. The tidal exchange in the premature infant may be as low as 12 cc. The normal newborn has a tidal exchange between 20 and 50 cubic centimeters, with a maximum of 180 cc. on crying. Therefore, the anesthetist must be especially conscious of dead space in the anesthetic equipment and must attempt to keep it at a minimum. Since dead space leads to carbon dioxide accumulation, every effort should be made to eliminate it and avoid any excess of this waste gas.

Circulatory System. Peculiarities of the child's cardiovascular system, important to the anesthetist, include——

Inherent Automaticity. The infant's cardiovascular system is difficult to upset. It seems to possess an inherent automaticity and power of regulation. Arrhythmias, other than sinus arrhythmias, are far less frequent during anesthesia of children than of adults.

Increased Heart Rate. Normal infants have a pulse rate between 80 and 180 per minute. In normal children the range lies between 80 and 120. A slow pulse rate is more significant than a rapid pulse rate and should warn the anesthetist of impending cardiac failure. A slow pulse rate or an arrhythmia in an infant is often a sign of insufficient oxygenation, even if the flow meter of the anesthetic machine indicates that an adequate amount of oxygen is being given.

When an arrhythmia occurs in the child who does not have a congenital heart abnormality, it can usually be corrected by increasing the oxygen content of the gases being inhaled, or by letting the child breathe 100 per cent oxygen for 10-30 seconds.

Low Blood Pressure. The child is natually hypotensive. The blood pressure of the newborn infant averages about 80/46 mm. Hg. It increases about 20 mm. Hg. during the first two weeks of life and usually remains at about this level for the next four or five years.

Blood Physiology. At birth, the infant's hemoglobin is 19 grams per hundred cc. of blood and 16 grams by the end of the second week. By the third month it is 11 grams. It is believed that no child should be operated upon unless his hemoglobin level is at least 10 grams.[1]

Blood loss during surgery is tolerated poorly by infants because they have a small blood volume (roughly 80 cc. per Kg.) and are naturally hypotensive. Therefore, it is mandatory that an intravenous infusion be started *prior* to surgery for all major procedures. If a venipuncture cannot be accomplished, then a "cut-down" must be performed. Infants also have a longer bleeding and coagulation time than do adults, and this increases the possibility of significant blood loss during surgery.

Central Nervous System. The central nervous system of the infant also presents variations from that of the adult. Most of them are due to the immaturity of the nervous tissue and result in——

Decreased Sensation. Infants under one month of age appear to be less sensitive to painful stimuli because the peripheral receptors of pain are under-developed. Therefore, minimal concentrations of anesthetic drugs will attain satisfactory anesthesia for surgical procedures.

Increased Incidence of Convulsions. The central nervous system in infants seems to be more irritable than that of adults, which explains the greater frequency of convulsions in anesthetized children. Factors such as anoxia, fever, dehydration, acid-base imbalance, premedication, etc., undoubtedly may be contributory.

Under-developed Temperature Mechanism. The heat regulating centers of the infant are immature and, therefore, great care must be taken in draping prior to surgery to avoid either undue exposure (heat loss) or over-draping (heat retention). Otherwise, the body temperature of infants under 6 months of age will change two or three degrees during surgery. External assistance should be given to maintain the body temperature as nearly normal as possible (e.g., blankets and carefully applied warm water bottles to maintain heat, and fewer drapes or ice bags to keep temperature down).

Special thermometers are obtainable at small cost, which may be placed either in the rectum or in the esophagus and which will give a continuous check on body temperature. If these are not available an ordinary thermometer may be placed in the axilla, with the baby's arm at his side, to indicate heat retention or heat loss.

Gastro-Intestinal System. The anesthetist should check to see that the patient to be anesthetized has an empty stomach. Aspiration of vomitus is as serious a complication in the child as it is in the adult. The gastric acid in vomitus, regardless of the size or age of the human being, will destroy the epithelial cells of the alveoli if it is aspirated. In addition, any food particles in the vomitus may plug the respiratory tree (trachea, bronchi, etc.) and may lead to a collapse of the lung unless these plugs are removed by thorough bronchoscopy.

During the course of anesthesia an infant frequently develops an acute distention of the stomach. The cause for this is unknown, for such distention can occur even in the presence of an endotracheal tube. Gastric distention causes pressure upon the diaphragm and seriously interferes with respiration. This must be relieved by gently passing an urethral catheter into the stomach and aspirating the air.

Urinary System. The child's kidney is much less capable of dealing adequately with excess amounts of saline than is the adult's kidney. At the same time, the water reserve of the child is relatively less, so he will become dehydrated more easily. When a child needs fluid, the solution of choice is probably 5 per cent dextrose in water, provided electrolytes are within normal limits and there is no anemia. Special care must be taken not to give large amounts of fluid over short periods of time. It is just as important not to overload the circulation as it is to supply replacement of fluid lost. Before the operation the surgeon and anesthetist should determine the maximum volume of fluid the child will tolerate, in addition to replacement of blood loss, and take steps to see that this amount is not exceeded. The bottle containing the intravenous fluid should be labeled with specific instructions, and the amount to be given should be plainly marked on it.

Preoperative Preparation

If the anesthetist is cognizant of all of these anatomical and physio-

logical variations in the child, the next step in successful pediatric anesthesia is the preoperative preparation. Evans[2] states that anesthesia in children should be "anesthesia without tears." This ideal can be accomplished either by psychology (sheer skill and craft) or by premedication.

Psychological Approach. The psychological approach consists principally of having the child admitted to the hospital the day before surgery so that he can become familiar with the hospital routine and staff under more pleasant and relaxed circumstances. *It is mandatory that the anesthetist visit the child during this time.* The operative routine is explained and an attempt is made to establish rapport and confidence. The child usually understands far more than adults would assume.

At the Seattle Children's Orthopedic Hospital, prior to administration of anesthesia, the child is brought to a pleasant induction room——such as the Peter Rabbit Room or the Cowboy Room. These rooms are decorated with murals and contain large, stuffed figures and toys. Such rooms tend to interest the child and relieve his anxiety of having to leave his parents and familiar surroundings.

Drug Approach. The second method of preparing the child for operation is by the administration of drugs. Opinion on the subject of premedication varies from Evans,[2] who states that "up to the age of two years, premedication is undesirable and unnecessary," to Stephen,[1] who states that premedication is "perhaps even more beneficial and necessary than it is for adults."

Oral premedication is rarely suitable for the infant or the young child, since he will not usually swallow a capsule, and even if he will, a large amount of water is also ingested, which may be vomited during anesthesia. Unconsciousness may be induced in children prior to anesthesia by administering drugs per rectum. In most instances the drug will not be expelled if the child has had a cleansing enema within 12 hours before the operation. It is an easy, pleasant way for the child to go to sleep and entails little psychological preparation. (The child may be told that it is just like taking a rectal temperature.) Tribromethanol (Avertin®) is administered in dosages of 60 to 100 mg. per Kg. of body weight or a 10 per cent Pentothal® or Surital® solution in dosages of 15 mg. to 20 mg. per pound. However, this technique is time-consuming and the results unpredictable. In addition, tribromethanol (Avertin) has a specific relaxant action on the masseter muscle, so that the airway must be watched more carefully, both before and after surgery. Drugs administered rectally also have a hypnotic effect for 4 to 6 hours, which may be undesirable in certain cases.

Of the premedicant drugs, morphine produces a release from apprehension and roseate hue (euphoria) as no other drug will. In proper dosages it can be safely employed in all ages over six months. Demerol is a satisfactory substitute and is easier for nursing personnel to measure, but lacks morphine's soothing effect on the higher cortical areas. Scopolamine is probably preferable to atropine because it is less likely to produce tachycardia, and its cerebral sedative effect reduces anxiety. It is also a superior drying agent. For determining exact dosage of particular drugs, a card has been compiled by H. W. Bissonnette, M.D. and Robert

E. Ploss, M.D. This card also contains valuable information on endotracheal sizes, transfusion requirements, etc.**

Administration Of The Anesthetic

Selection of the Anesthetic Drug. Once the child has arrived in the operating room, adequately prepared, the anesthesiologist must choose an anesthetic agent and technique for administering it. As Macintosh and Bannister so ably stated, "too much attention is often paid to the supposed safety or danger of a particular narcotic drug as indicated by available statistics. An anesthetic is made safe or dangerous by the one who administers it—avoidance of anesthetic accidents undoubtedly depends far more on the experience, care and skill of the anesthetist than on the choice of any particular agent."[2]

Therefore, specific agents or techniques for specific operations such as cleft palate, tonsillectomy or cardiac surgery, will not be recommended in this paper. If the physiological peculiarities of the infant are recognized, the agent and technique which is safest for a given procedure is the one with which the anesthetist is most familiar and which he can use most skillfully. In observing anesthesia in various institutions around the country, one is continually impressed with the number of methods which are used and used well for any given surgical procedure.

Ether and nitrous oxide are probably the safest agents for pediatric anesthesia because the child passes through the stages of anesthesia slowly when these agents are used. The more potent agents such as cyclopropane, Vinethene®, trichlorethylene, Vinamar® and Pentothal® are extremely valuable agents when administered by those trained in their use. But since their potency decreases the margin of safety, they should be avoided by the part-time anesthetist.

Curare and Muscle Relaxants. The advent of muscle relaxants revolutionized anesthesia for adults. Attempts have been made to carry their use into pediatric anesthesia. However, the newborn infant is extremely sensitive to d-tubocurarine. This hypersensitivity indicates extreme caution in the use of this drug, especially since it is doubtful whether a reliable reversal of action of the d-tubocurarine can be obtained in the newborn. However, the British have successfully used succinylcholine in dosages of 5 mg. intravenously, or intramuscularly in dosages of 1-2 mg. per Kg. of body weight, with 150 TRU hyaluronidase added. They report no cases of prolonged apnea.[3]

Technique of Administration. The method of administering the anesthetic drug to infants and children is chosen according to the requirements of the surgery and according to the physiological considerations pertaining to the infants. Each technique has specific advantages and disadvantages which every anesthetist should know. Whichever technique is chosen, the anesthetist should be impressed with the need for observing his patient constantly. Children pass through stages of anesthesia rapidly, and minute to minute checks of pulse and respiration must be made. Taping a stethoscope to the anterior chest of the child and the use of a plastic hearing aid mold as advocated by Ploss, has enabled the anesthetist to monitor pulse, blood

**Available from R. A. Hawks Division, Sierra Engineering Co., Sierra Madre, Calif.

pressure and respiration throughout the surgery.

The Open-drop Technique. A liquid is vaporized by dripping it on some type of mask covering the face. This is the oldest and commonest technique employed in pediatric anesthesia. Regardless of the training or ability of the anesthetist, it is probably the safest of methods.

Its advantages include: (1) simplicity of equipment and administration; (2) a greater margin of safety resulting from the greater period of time between respiratory arrest and circulatory arrest if ether is being used. Merely removing the mask will lighten too deep anesthesia within a minute or two.

The disadvantages may be listed as: (1) the effort the infant must exert to draw air through some types of masks may be fatiguing; (2) the area under the mask constitutes a considerable amount of dead space and CO_2 accumulation is, therefore, common; (3) rebreathed vapor, CO_2 and air may reduce the O_2 concentration under the mask to 15 per cent; (4) respiration cannot be manually assisted; (5) perfection of the technique requires long experience; and (6) only one drug can be administered efficiently at one time.

The Insufflation Technique. This consists of blowing anesthetic mixtures into the trachea and pharynx by means of a motor-driven blower, or flowing a large volume of gases from the anesthesia machine. The mixtures are usually administered through a mouth hook, nasal hook or catheter, or through a metal oral pharyngeal airway. This is a simple, comparatively safe technique; but there is no guarantee of a patent airway and no means of artificial inflation of the lung are available. When this technique is to be used, the open drop method is usually indicated for induction. Prolonged insufflation of gases does not provide normal respiratory exchange and may lead to accumulation of carbon dioxide in the lungs. The principal advantage of the system again is simplicity of equipment.

The Fractional Rebreathing Technique or Semi-closed System. This is a system in which high flows of gases (equal to the minute respiratory volume of the patient) are run into a reservoir which is connected near the face mask or tube leading to the patient. In this tube is an expiratory valve, through which part the exhaled air is blown. This system usually includes a Slocum tube, a Turnbull-Compton connector, Ayres tube, or a Flagg can. The technique is simple and respirations can be quickly assisted if necessary.

Because some of the anesthetic vapor is exhaled into the air and some of the gases are diluted by air during inspiration, it is difficult to maintain deep planes of anesthesia by inhalation alone. Therefore, the partial rebreathing technique is usually used for operations not requiring deep planes of anesthesia.

The Non-rebreathing Technique. This system incorporates an inspiratory and an expiratory valve in the apparatus so that all exhaled gases are removed from the system. Thus, the hazard of carbon dioxide accumulation is eliminated, as is the need for soda lime. This technique fulfills the desired requirements of children's anesthesia more closely than any other method. Several such valves are available, including the plastic Leigh valve, the Stephen-

Slater valve and the Fink modification of the Stephen-Slater valve.

The advantages of this technique are: (1) minimal dead space——the dead space in the equipment itself is reduced to 9.0 cc., which is not more than is found in the mouth of a tiny infant; (2) minimal resistance——the estimated resistance in the system of 1.0 to 1.75 cm. of water will permit anesthesia of tiny infants to be maintained for two to three hours without development of fatigue; (3) safety——the presence of the reservoir bag in the system permits assisted or controlled respiration without difficulty; and (4) versatility——a variety of anesthetic drugs may be administered: the most common combination being nitrous oxide, oxygen and ether.

Drawbacks of the technique include: (1) the requirement of large volumes of gases; and (2) complexity of equipment which increases the possibility of failure and CO_2 accumulation.

Closed Absorption Technique. In this technique, small volumes of gas are passed through soda lime to remove the carbon dioxide. Most anesthesia machines can be equipped with a valve so that the machine can be used for either the closed circle absorption system or the to-and-fro system.

The circle absorption system, commonly found on all anesthesia machines, should not be used for children under 7 years of age. It presents too much resistance to gas flow in the accordion tubes which connect the patient to the machine, in the directional valves which govern the flow of the gases in the machine, and in the canister containing soda lime for carbon dioxide absorption. Continuous manual assistance of respiration will aid in prevention, but will not wholly prevent, the development of fatigue. The circle system is suitable for adults, but the practice of carrying children under 7 years of age on this system should not be employed.

Recently, both the Foregger and Ohio Chemical Companies have developed infant circle systems which reduce this resistance somewhat, but cannot be relied upon to remove all the CO_2 automatically. The anesthetist must be constantly aware that even with these systems, difficulty may arise from CO_2 accumulation.

In the to-and-fro system, the soda lime canister is connected directly to the mask or endotracheal tube. This is valuable in children over 18 months of age providing the soda lime canister is of such size that it is equal to the tidal exchange of the child. There are 4 sizes of canisters—the 90 gram size for the infant under one year of age, the 180 gram size for the child 1 to 3 years of age, the 350 gram size for the child 3 to 10 years of age, and the 450 gram size (normal adult size) for the child over 10 years of age.

The canisters should be changed every 10 to 20 minutes to prevent the temperature of the respired gases from becoming too high and contributing to the child's body heat, i.e., heat retention. Changing the canister frequently also ensures peak efficiency of the soda lime in removing CO_2.

Intravenous Anesthesia. This is reserved primarily for older children because the cooperation of the young child for venipuncture cannot be relied upon. Likewise, the agents used are profound depressants and are usually used in combination with inhalation anesthesia.

Spinal Anesthesia and Regional Block Procedures. These techniques are used in children infrequently because of the difficulty in obtaining the child's cooperation and understanding. However, in cases where they are indicated, spinal anesthesia may be used, e.g., Pontocaine® in a dosage of 1 mg. per year of age. If regional block is used, most children should be kept asleep during the operation to avoid unnecessary psychic trauma.

Hypothermia. During the past few years, lowering of body temperature has been employed to reduce the oxygen requirement of the tissues temporarily by lowering body metabolism. This permits surgical correction of certain congenital heart defects, as well as surgery on an acutely ill, febrile toxic child with a tachycardia——a condition which may normally carry a high incidence of morbidity or mortality.

The technique is accomplished by immersing the anesthetized child in ice water or packing in ice chips. An infant cools more rapidly than a child because of the scanty subcutaneous tissues and large body surface in relation to the small muscle mass. The patient must be watched carefully to prevent too rapid or too profound a drop. *This point cannot be stressed too strongly.* A couple of ice bags on a small infant is often all that is necessary to lower his body temperature sufficiently to permit surgery.

It has been found that the oxygen demand of the tissues is reduced 50% by reduction of the body temperature to 28° C. (82.4°F). This is apparently a safe level for infants, providing arterial oxygen saturation is maintained.[4]

This technique requires not only considerable anesthetic equipment and a skilled anesthetist, but an internist who can accurately interpret the findings of the constantly recording electrocardiogram, which should be connected to the child when hypothermic anesthesia is to be undertaken. It must be stressed that this technique should not be undertaken in a willy-nilly fashion, but by a "team" which realizes the problems involved.

Endotracheal. Whichever of the above anesthetic techniques is chosen, a means of administering intermittent positive pressure oxygen, including a laryngoscope and endotracheal tube, must be available in case of emergency.

Preservation of an unobstructed airway is essential. The increasing realization of the importance of an unobstructed airway has led to more frequent use of endotracheal tubes in recent years. The advantages of intubation are: (1) material reduction in the amount of dead space in the system; (2) assurance of a patent airway; (3) easily accomplished suctioning of the tracheobronchial tube at any time; and (4) better working conditions for the surgeon and greater safety to the patient in operations in the region of the head and neck.

The disadvantages consist of: (1) technical difficulties in intubation due to anatomic differences in children; and (2) occasional hoarseness and laryngeal edema postoperatively. The second mentioned disadvantage is usually due to the vocal cords contracting in an effort to expel the endotracheal tube. Deeper anesthesia and a smaller tube, lubricated with a water soluble anesthetic ointment, eliminate this problem.

Nasal tracheal intubation is rarely done in children unless specifically

indicated, because of the danger of bleeding and the possibility of injury to the adenoid tissues.

A laryngoscope blade which is not too large and a soft endotracheal tube should be selected for endotracheal intubation. The anesthetist should select at least three tubes—one estimated to be the correct size, one a size smaller and one a size larger. A rule of thumb for selection of the Magill size of endotracheal tube is two-thirds of the age of the child in years. Vinyl plastic tubes are usually used because they mold easily at body temperature without kinking or sacrificing the lumen of the tube. They cause less trauma and fewer postoperative complications than the rubber tubes because they are usually softer.

Improper extubation can cause severe laryngospasm and anoxia. This can be minimized if the patient is well oxygenated, the pharynx and nasal passages thoroughly suctioned, and the tube removed during the expiration phase of respiration. The anesthetist must be prepared to administer oxygen by bag and mask immediately after extubation.

Postanesthesia Period. Most children who are anesthetized by a skilled anesthetist with the aid of these modern techniques emerge from the operating room in good condition. Usually their reflexes have returned. If not, the anesthetist has suctioned the air passages, has inserted an oral airway or so positioned the child that a patent airway is insured. Whenever possible, the child should be returned to a recovery room which is located immediately adjacent to the surgical suite, so that the anesthetist is immediately available. Adequate numbers of skilled, trained personnel should have oxygen and suction at the head of each bed and specialized equipment such as isolettes and incubators, drugs, etc., immediately available.

The anesthetist who has taken cognizance of the physiological variations in the infant, and employed the methods outlined above, will receive a great sense of satisfaction in a job well done. On postoperative rounds he will see these children happy, without fear, and well on the road to rapid recovery following a surgical procedure which only a few years ago would have been fraught with complications and high postoperative mortality.

Summary

This paper attempts to point out the requirements for safe pediatric anesthesia. The anatomical and physiological variations of the child and the various techniques available to the anesthetist are discussed. A plea is made for those administering children's anesthesia to use the drugs and techniques with which they are most familiar and to use them cautiously. If this is done pediatric anesthesia will truly be "anesthesia without tears"—on the part of both child and parents.

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Black Magic and the Myoneural Junction

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Surgeons and patients have almost always seen eye-to-eye on the objectives to be accomplished by surgical intervention, but they have rarely come even close to agreement as concerns the objectives of the anesthetic procedure. The patient's concept of a successful anesthesia is an immediate, painless, and total oblivion. The surgeon's concept is somewhat more embracing. It includes, of course, immediate, painless, and total oblivion, since this is the desire of his patient; but it also includes a totally flaccid patient, preferably one incapable of bleeding, and certainly one who will run an entirely uncomplicated postoperative course. There is a world of difference between these two demands; and yet it would be no exaggeration to state that it is, in fact, a Lilliputian world. For the difference between the patient's concept and the surgeon's concept of the successful anesthetic procedure is the myoneural junction. The developments of the past few years have suggested that it might be appropriate to ponder the effect of this microscopic entity, the nerve-muscle junction, upon anesthetic practices.

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Ether Anesthesia

In the beginning there was only ether. The problem was not what to do, but how to do it. The purpose was the production of a reversible state of unconsciousness, since unconsciousness would provide relief from the perception of pain. The technique, as described by a Boston surgeon in the 1860's, has become ageless in its naked virulence:

"A towel rolled into a cone, with a napkin or sponge pushed to the top of the inside, is all we need to pour our ether on, whilst our fingers can mound it over any mouth and nose. Some years ago I often heard in Europe medical gentlemen say, 'But there are so many people who cannot take ether.' I have yet to see one. The truth is, I believe, that surgeons are afraid of ether, and do not dare to give enough of it at once in the commencement. Now if the patient is warned that the ether will choke him, and told when this occurs to take long breaths to relieve it, and not to struggle and endeavor to push away the sponge, many will go to sleep quietly and without trouble to themselves or the surgeon. I have but one other point to speak of in reference to giving ether. When the patient, whether old or young, struggles, and asks for respite and

fresh air, do not yield. Hold them down by main force, if necessary, and at any rate, keep the sponge tight over the mouth and nose till they finally take long breaths and then go off into ether-sleep. Doing this prevents their remembering anything about their struggles. It is absurd to stop the ether and try to reason with adults excited by the anesthetic, and cruel not to push on quickly with children."

In retrospect, both the purpose and the technique appear unseemingly crude, from either the patient's or the surgeon's viewpoint; yet at the time of Morton's demonstration of clinical anesthesia in 1846, the introduction of ether prompted so distinguished a British surgeon as Liston to exclaim, "this Yankee dodge beats mesmerism hollow." As with most Yankee dodges, however, it was one that demanded its own particular pound of flesh. The surgeon, rightfully and justly, began to long for those degrees of muscular relaxation that permit him the facile accomplishment of surgical intervention, without the concomitant toxicities of deep ether or deep chloroform anesthesia. What lay between him and the accomplishment of this ideal was, of course, the myoneural junction. And a formidable barrier it was, too.

Local Anesthesia

In the summer of 1884, Koller proclaimed the effectiveness of local anesthesia: "The fact that cocaine locally applied paralyzed the terminations and probably the fibers of the sensory nerves had been known for twenty-five years before it came to the attention of someone interested and desirous of producing local anesthesia for the performance of operations.

"It is not correct, as was said at the time, that I discovered this important fact by accident, a drop of the solution coming by chance into my eye... when in the course of preparing for the physiologic experiments, I realized that I had in my possession the local anesthetic which I had been previously searching for, I went at once to Sticker's laboratory, made a solution of cocaine and instilled a drop in the eye of a frog, and afterwards of a guinea-pig. I found the cornea and conjunctiva anesthetized... Afterwards, I repeated these experiments on myself, some colleagues and many patients."

Koller's discovery of the anesthetic effects of cocaine served to open up the vast fields of conduction or regional analgesia, and laid the groundwork for a new approach to the problem of the myoneural junction. It was no longer necessary to subject the patient to horrendous depths of protoplasmic poisoning to obtain those ideal working conditions that are so necessary to definitive surgical therapy. Epidural, spinal, and the various forms of nerve block analgesia provided excellent working conditions for the surgeon at far less metabolic cost to the patient than deep general anesthesia.

It should be noted, however, that these various forms of conduction analgesia are just that: i.e., analgesia rather than anesthesia. The patient's concept of anesthesia as an immediate, painless and total oblivion was being neglected until George Crile, Senior, propounded his theory of "Anoci-Association" in 1911. Crile, reasoning along physiological lines, argued that not only must the brain be protected against destructive psychic strain by the use of general anesthesia, but the local anesthesia must

also be employed to exclude noxious impulses arising from the site of surgical interventions. He pointed out that although such double protection could be achieved by very deep general anesthesia produced with only one agent—such as chloroform or ether—the cost to the patient in terms of deranged metabolism would be too immense to be feasible.

Lundy adopted a similar line of reasoning in 1926 when he coined the term "Balanced Anesthesia", which he employed to designate the use of a combination of anesthetic agents and methods so balanced that the burden of the relief of pain would be borne in part by the preliminary medication, in part by regional anesthesia, and in part by light general anesthesia.

There were therefore attempts to achieve a compromise between the patient's concept of anesthesia and the surgeon's concept. And, it should be added, they went far along the road in that direction. The introduction of pentothal in the year 1933 by Lundy and Tovell was without question a milestone, and one that was an incalculable boon to the patient. Here, indeed, was "an immediate, painless, and total oblivion"; and one which tipped the scales of anesthesia far towards the patient's desires. The surgeon's need for "a totally flaccid patient——preferably one incapable of bleeding, and, certainly, one who would enjoy an absolutely uncomplicated postoperative course", was being neglected.

Curare Leads To Combined Anesthesia

Then suddenly, during January of 1942, at a small general hospital in the city of Montreal, all that changed. For during the course of operation, resort was not had to the usual procedure of deepening the level of cyclopropane anesthesia to achieve muscular relaxation; instead, the dread poison of the South American Indians was injected, intravenously, by Dr. (now Professor) Harold Griffith, to produce an utter flaccidity in the surgical field. The sheer brilliance of Griffith's contribution to anesthesiology has now dominated the trend of the specialty for over a decade. The introduction of curare prompted Dr. T. Cecil Gray of Liverpool, to write this concerning the historic event: "Griffith of Montreal observed the softening of convulsions by tubocurarine, and in a flash of inspired genius saw its application to anesthesia. He revolutionized our specialty by removing for all time the need for deep anesthesia." It was a milestone of progress in anesthesia almost without equal since the classic public demonstration of ether more than a century ago. But the importance of Griffith's presentation lies not so much in the drug itself, as in the fresh approach which it introduced into anesthetic thought concerning the clinical pharmacology of muscular relaxation. For here was the myoneural junction at bay, subjugated by a combination of the black magic of the Indians and the bold, imaginative mind of a true pioneer.

The introduction of curare led to the development of Combined Anesthesia, a combination of light anesthesia and full muscular relaxation. In Combined Anesthesia, minimal amounts of an hypnotic (pentothal), an analgesic (nitrous oxide, ethylene, or light cyclopropane), and a muscle relaxant (curare, or one of its numerous analogues) are used in combination to produce adequate conditions for surgery without recourse to deep

general anesthesia and its attendant physiological disturbances.

The precise action of the muscle relaxant drugs in producing muscular flaccidity seemed an answer to a problem of considerable magnitude, and yet, already the wave of condemnation has set upon these drugs. The hypothesis has been advanced that where the muscle relaxants are employed, there is an appreciable increase in the anesthesia death rate. The statement has been that the employment of these drugs "appears to be associated with certain anesthetic hazards not yet entirely clear, nor completely appreciated"; the implication has been that the magic is indeed black. That the muscle relaxant drugs can kill is certainly true—ask any South American Indian. But whether they do so because of an inherent toxicity, or whether the so-called "curare deaths" are, in fact, the results of misuse of these drugs, is a point worth pursuing. Let us examine, in turn, the myoneural junction, the muscle relaxant drugs, and the clinical usage of those drugs.

The Myoneural Junction And Muscle Relaxants

The myoneural junction is the terminal aborization between nerve axon and muscle fiber. Kuffler has pointed out that "the end plate has become, in recent years, a physiological entity which at present cannot be strictly identified with the structure of the histologists". The motor axon, central to its point of contact with the muscle fiber, is surrounded by the Schwann cells, which in turn are enclosed in the neurilemma. The myelin sheath is lost near the end plate region, and at that point, beneath the axon, is found the pallisade-like subneural apparatus. It is this subneural apparatus which is the probable site of both the acetylcholine-receptor substance, where the end plate potential is initiated, and most of the acetylcholine-esterase of the end plate.

An understanding of the mechanism of normal transmission of nerve impulses is germane to an intelligent appreciation of the physiological activity of the myoneural junction. The resting nerve axon is in a polarized state, there being a difference in electrical potential between the two sides of its surface membrane. This electrical charge is maintained by oxidative metabolism, and is associated with the utilization of oxygen and the production of carbon dioxide. Furthermore, this surface membrane is normally more permeable to potassium than to sodium ions, so that there is a greater concentration of potassium intracellularly, while sodium predominates in the extracellular fluid. As the nerve impulse, or wave of excitation, passes along the nerve axon, the surface membrane is depolarized. And, as this transient wave of negativity spreads along the nerve fiber, it not only removes the polarity of the membrane, but it is also associated with changes in membrane permeability——the resistance of the membrane dropping to about two per cent of its resting level during the depolarization of action potential. The great increase in the permeability of the surface membrane permits a sudden migration of sodium ions across the membrane, and there is an equal and almost simultaneous movement of the intracellular potassium ions in the opposite direction until membrane potential is restored and excitation ceases.

It is believed that the active state of the nerve is the result of this great

increase in permeability to sodium, which produces an action potential exceeding the resting membrane potential, thus reversing the polarity of the membrane. During the conduction of the nerve impulse, all this metabolic activity results in an increase in oxygen utilization and carbon dioxide production to about the twenty per cent level. Following the passage of the wave of excitation, the nerve is in a refractory state, incapable of further activity, until a gradual movement of ions back across the membrane restores the concentration of intracellular and extracellular sodium and potassium to normal, and re-establishes the polarity of the surface membrane of the nerve.

As the wave of excitation passes down the nerve to reach the myoneural junction, transient depolarization proceeds concomitantly, and includes the nerve end-plate. This structure is invaginated into the substance of the muscle fiber, but remains nevertheless epimyal. It initiates junctional activity, and, following a "synaptic delay", a response in the contiguous muscle sole plate by a sudden and instantaneous rise in the concentration of acetylcholine in the vicinity of the subneural apparatus. Depolarization of the muscle sole plate spreads from that structure over the muscle cell, and the muscle then contracts. After the wave of excitation has passed, the nerve end-plate is repolarized; the concentration of acetylcholine in the vicinity of the subneural apparatus is decreased rapidly, due to hydrolysis of acetylcholinesterase; the muscle sole plate is repolarized; and the muscle relaxes.

Claude Bernard's classical experiments, elegantly conceived and meticulously executed, demonstrated, almost a century ago, the effect of curare upon this amazing mechanism of myoneural transmission. Bernard showed that the muscle of an isolated frog nerve-muscle preparation, when exposed to curare, did not respond to a stimulus applied to the nerve; however, the muscle did respond to *direct* stimulation, and the nerve did continue to conduct stimuli throughout the length of its axon. In other words, the action of curare is on neither the nerve itself nor upon the muscle, but is pinpointed at the myoneural junction. This, then, is the *sine qua non* for muscle relaxant activity: interruption of nerve-muscle transmission, without direct action upon either the nerve or the muscle. Furthermore, it has been established that the muscle relaxants do not interfere with the elaboration of acetylcholine in response to depolarization of the nerve end-plate. This fact has served to pin-point further the action of the muscle relaxant drugs at the muscle sole plate; and the hypothesis has been advanced that, when curare has been administered, acetylcholine becomes incapable of depolarizing the muscle sole-plate because the curare itself is a quaternary ammonium compound that "occupies" the particular receptor areas on the muscle sole plate normally acted upon by acetylcholine. This concept of receptor areas which normally accommodate acetylcholine activity, has given rise to the nomenclature "block by competition". Muscle relaxant drugs which act in this manner are thus spoken of as "competitive blockers": by blocking the action of acetylcholine at the muscle sole plate receptor areas, they prevent depolarization of the muscle sole plate, and hence inhibit muscular contraction.

This hypothesis fails to explain the action of all muscle relaxant drugs

at the myoneural junction. Decamethonium, for instance, appears to act in a somewhat different fashion. When it is applied to an experimental nerve-muscle preparation, it will, at first, produce an augmented muscle contraction in response to single indirect shocks applied to the nerve. It is as though the drug served to intensify the action of acetylcholine. Such augmentation is short-lived, however, and the preparation soon responds with decreasing contractions to the continued application of submaximal single shocks because of the fact that the myoneural junction fails to repolarize. Decamethonium, therefore, exerts its action by persistent depolarization, and is the prime example of the so-called "depolarizing" blockers.

Recently, these pat explanations of muscle relaxant activity have been further complicated by the clinical recognition of a blocking mechanism that combines elements of both "competitive" block, as represented by d-Tubocurarine, Flaxedil, Mytolon, and Laudolissin, as well as "depolarization" block, as represented by the action of Decamethonium and succinylcholine. The mechanism has therefore been termed "mixed" or "dual" block, and has been postulated as an explanation for the occasional cases of prolonged apnea which may follow the use of large doses of muscle relaxant drugs——particularly the "depolarizing" blockers.

The Pharmacodynamics of Muscle Relaxant Drugs

An understanding of the actions of the muscle relaxant drugs at the myoneural junction is of more than mere passing academic or pedagogic interest, and has clinical implications of considerable import for the anesthetist. So, too, does an understanding of the pharmacology of the various, individual muscle relaxant preparations. In general, despite differing modes of action at the myoneural junction itself, and with certain few but important variations, all the muscle relaxant drugs presently in clinical usage follow a similar pattern of physiological effects.

Curare, as represented by d-Tubocurarine, is the grandfather of all muscle relaxants and may serve as a standard in this regard. By far the most important pharmacological effect of curare is, of course, the muscular relaxation which it produces because of its blocking effect at the myoneural junction of skeletal muscles. This relaxation comes to include all of the skeletal muscles of the body, including the diaphragm and the intercostal muscles, if the dose of curare is increased to a sufficient extent.

There is, according to the textbooks, a very definite sequence of relaxation, by muscle groups, so that the diaphragm and the intercostal muscles are said to be the last to be paralyzed. But——unfortunately, not all patients have bothered to read the textbook carefully, and the anesthetist must assume that any or all muscle groups may be affected by a given dose of the drug. It follows that a single small dose of curare may, and in all probability will, decrease respiratory exchange, even though such decrease in respiratory exchange cannot be seen clinically. Furthermore, with increasing doses of the drug, such decreased respiratory exchange will progress to total apnea; and it is worth noting that, in certain patients—who did not even look at the cover, let alone read the book—such apnea may occur when even extremely small doses of the drug have been administered. These effects

upon the respiratory system are of maximal significance to the anesthetist. The effects upon the central nervous system are usually of far less significance, but it should be pointed out that curare's action is not restricted to the peripheral aborizations of the nervous system at the myoneural junction, but may occur at other sites where acetylcholine acts.

McCawley has demonstrated that enormous doses of the drug will produce effects upon the brain itself; however, it should be added immediately, that such doses would never be employed clinically, and that no effect upon consciousness or the perception of pain must ever be expected of a muscle relaxant drug.

Scott Smith's astounding experiment, wherein he was administered a dose of 500 units, or more than two and one-half times the total paralyzing dose, of d-Tubocurarine intravenously, proved that there were no changes in the electro-encephalogram, consciousness, or sensorium.

The effect of curare on the nervous system may be of considerable importance when its site of blocking action is at the autonomic ganglia, however, for in certain susceptible patients the ganglionic blockade and is so produced may cause a profound fall in blood pressure due to post-ganglionic vasodilatation. And again, it is worth noting that a very small dose may occasionally precipitate such a reaction. A similar effect upon the cardiovascular system may occur in patients in whom the drug induces the liberation of histamine, for histamine release may produce severe hypotension, as well as bronchospasm, laryngospasm, and increased secretions. These toxic effects are rare, but the awareness of their possibility is of great importance to the intelligent clinical use of the drug. Finally, it must be emphasized that when the effect of curare is wearing off, the resumption of skeletal muscle activity is usually a gradual process, so that decreased respiratory exchange is a persistent phenomena during the recovery period from curarization.

Flaxedil, or *Gallamine Triethiodide,* is a synthetic muscle relaxant of shorter duration than curare, but is otherwise very similar in its actions. Unlike d-Tubocurarine, Flaxedil does not cause the release of significant amounts of histamine, so that blood pressure is not depressed even with large doses, and bronchospasm does not occur. The drug does cause a moderate sinus tachycardia, probably as a result of a weak and selective parasympatholytic action on the heart. The latter property has prevented the drug from enjoying the same widespread popularity in this country that it does in Great Britain and Europe.

Mytolon is another synthetic muscle relaxant drug that acts as a "competitive" blocker at the myoneural junction. It is a bencoquinonium compound that, in man, is of greater potency, but shorter duration, than d-Tubocurarine. It does not release histamine when administered in clinical dosage, but it possesses powerful parasympathomimetic properties, and truly full atropinization is necessary to prevent lacrimation, excessive salivation, profound bradycardia, and even circulatory collapse. Its manufacture has recently been discontinued for these various reasons.

Laudolissin, or *Compound 20,* is a synthetic heterocyclic bisquarternary ammonium substance that is of considerably longer action than d-Tubocurarine. In addition, there is definite clinical evidence that the drug has a

cumulative effect when administered in repeated doses. These two facts combined have produced, on occasion, a duration of action that has been extremely prolonged. The drug has never had an extensive usage in this country, possibly because, while there is the occasional very slow surgeon, there are none who are as slow as all that.

The muscle relaxant drugs which interrupt myoneural transmission by "depolarization" block—*Decamethonium* and *succinylcholine*—produce physiological effects which follow the same general pattern as those produced by d-Tubocurarine and the other "competitive" blocking agents. Decamethonium is the ten carbon atom homologue of the polymethylene series of methonium compounds, and is an extremely potent neuromuscular blocking agent. But despite the fact that it is several times more potent than d-Tubocurarine, its duration of action is quite a bit shorter. Since its action at the motor end-plate is one of persistent depolarization, it may produce transient fasciculations following its administration; and, for the same reason: anticholinesterases will have no effect upon the block produced by this drug. Tachyphylaxis develops after repeated administrations of the agent, and may be seen clinically. Decamethonium does not release histamine in appreciable amounts in the doses usually employed, and it does not exhibit the ganglionic blockade typical of the five and six carbon atom members of this homologous series——pentamethonium and hexamethonium. On occasion, the drug has produced extremely long periods of apnea, despite reasonable dosage, and it has been hypothesized that this is the result of a "mixed" block.

Succinylcholine or diacetylcholine, produces a similar pattern of physiological effects, but it has one characteristic that is of extreme consequence: its very brief activity. A paralyzing dose of this drug is dissipated within a matter of moments, so that it has been possible to employ succinylcholine as a continuous intravenous infusion or as a single dose administration. Herein lies the great advantage of the drug—*almost absolute controllability of both the degree and the duration of relaxation.* Muscular paralysis may be kept at a level just below that of normal muscular tone; it may be carried to apnea and total flaccidity, or to any intermediate stage. Similarly, the desired degree of relaxation may be maintained for a minute or two, or may be sustained for many hours. Succinylcholine does not release histamine, and ganglionic blockade does not occur within the range of dosage that is employed in clinical practice. The drug comes very close to being the ideal muscle relaxant. Its single drawback has been the occasional production of prolonged durations of apnea. There have been almost as many theories as to the causation of this phenomena as there have been instances of its occurrence, but it is probably fair to say that most have been at least in part, frank misuse of the drug——which leads immediately to the final category to be considered in relation to the so-called "curare deaths".

Controlling The Black Magic

The action of the muscle relaxant drugs at the myoneural junction is not such as to kill if it is controlled on an intelligent basis. Nor are the toxic side reactions, of those members of this group of drugs which have

survived clinical trial, of sufficient severity or frequency to account for the reputation which is being forced upon the muscle relaxants. Indeed, these drugs are considerably less toxic than, say, digitalis. The lethal effects of curare and its related analogues must therefore lie in their clinical use—or rather abuse. Herein lies the crux of the "curare problem". It has been pointed out that "it is a curious fact that pioneers in any field of endeavor often either instinctively or intuitively find the correct ways of performance, and then enunciate their intuitive know-how as guides".

Such guides were carefully laid out in regard to the use of the muscle relaxants by the earliest workers; it would appear to behoove all to obey them: (1) do not administer a muscle relaxant drug if you are incapable of providing the patient with proper artificial respiration at all times and under any circumstances; this must include the ability to perform endotracheal intubation at all times and under any circumstances should the need arise; (2) always administer a test dose—only by such means is it possible to detect the patient susceptible to overdosage, to the release of histamine, or to ganglionic blockade; (3) always assist respirations, no matter how small the dose that has been administered, or how well the patient appears to be respiring, and provide oxygen in excess of minimal requirements; (4) employ "assisted" rather than "controlled" respirations—the respiratory function, including rate, rhythm, depth, and phasing, offers the only sign that is truly reliable for estimating the need for either more anesthetic agent or a further dosage of muscle relaxant; (5) never rely upon an antagonist to effect the restoration of muscle function—these drugs are capable of lethal action themselves and may have extremely complex actions in the presence of certain of the muscle relaxants, and often provide only a temporary reversal of the muscle relaxant's activity; (6) never allow the patient to leave the anesthetist's care until all possibility of continued muscle relaxant activity has passed.

The muscle relaxants are good, even magnificent drugs. They are capable of being tools of enormous clinical utility. They give promise of permitting resolution of the discrepancy between the patient's concept and the surgeon's concept of the objectives of anesthesia. They will scarcely do so, however, if they are misused.

Anesthesia for Adrenalectomies

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With the introduction of bilateral adrenalectomies, another problem in the field of anesthesia has arisen, since this surgery is performed only in the terminal stage of metastatic carcinoma after all attempts at medical treatment have failed to alleviate any symptoms. Consequently, the anesthetist is confronted with a patient who is apprehensive, debilitated and has developed a great tolerance to drugs.

Bilateral adrenalectomy was first performed successfully in man, in 1954, by Huggins, but at that time life could not be maintained in the absence of both adrenals, and it was not until cortisone had been produced that total adrenalectomy became clinically applicable in 1951.[1]

More literature is available for treatment and results of cancer in the female patient on the basis of hormones, glandular function, and surgical intervention than is available at the present time on the male patient. However, it may be well to outline what information is available on the treatment of metastatic carcinoma of the prostate.

Surgical Intervention And Therapy

Removal of the gonads and adrenal glands in treatment of cancer is based on the fact that if malignancy develops in tissue which is normally influenced by hormonal secretion, this hormonal relationship may be transmitted to the neoplasm arising in such tissue. Such malignancies may be stimulated or inhibited by the administration or withdrawal of appropriate endocrine substances.[1]

Temporary remission of androgen dependent metastatic carcinoma of the prostate occurs in some cases after orchidectomy and estrogen therapy. Similarly, efforts toward control of pituitary influence have been made through irradiation therapy of the pituitary and by means of hypophysectomy. Experience has been too meager for more than passing comment. Radioactive colloidal gold treatment has been used by Flocks and Burns since 1951 in the treatment of inoperable cancer of the prostate. A certain amount of radioactive gold is carried by the lymphatics to primary nodes and may have a destructive effect on any cancer cells which have reached these structures.[1]

Bilateral adrenalectomies were done on six male patients by Dr. Edward Ray, Lexington, Kentucky, in which the growth was reactivated

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*Daniel Drake Memorial Hospital, Cincinnati, Ohio.
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after a period of remission following castration and estrogen therapy. These patients responded in varying degrees to the procedure. Five obtained marked relief of pain, one of which returned to normal activity. The other died seven and one-half months later with no relief.[1] In conclusion of the treatment of cancer of the prostate, it seems to be the concensus of opinion that castration and estrogen therapy without bilateral adrenalectomy is more effective in the male than oophorectomies combined with administration of androgen for the female.

Bilateral adrenalectomy has been found to be an effective procedure in the treatment of metastatic carcinoma by Huggins. Others have substantiated these results. According to Huggins and Dao the following criteria are advocated for the best results: (1) if the patient is 40-65 years of age; (2) if there is an interval of two years or more between radical mastectomy and onset of recurrence; (3) if the estrogen titre of the urine is high; and (4) if the remaining breast shows evidence of milk secretion with administration of luteotropin.[2] Huggins reports that regression occurred following surgical intervention in most of the cancers that were predominantly papillary neoplasms or adenocarcinomas; duct carcinomas *rarely* and undifferentiated mammary cancers *never* responded favorably.[3]

Bilateral adrenalectomy does not constitute total adrenalectomy in many patients according to Dr. Graham, Memorial Hospital, as accessory adrenal cortices in the region of the celiac axis were revealed in 32 of 100 autopsies performed——which may account for manifestations of adrenal deficiency when cortisone is withdrawn following this surgery in some patients and not in others.[4]

As to the clinical picture, there are reports of tests on a number of different types of carcinoma in which bilateral adrenalectomies were done. From these cases, it was definitely noted that the prostatic and breast cancers ——the only ones to show improvement —— had orchidectomies and oophorectomies, respectively, as well as bilateral adrenalectomies.

At the present time, the prognosis appears to be better in the female than in the male. However, it is realized that this is still a palliative procedure, not a curative one, and is resorted to only after all other attempts to afford relief to the patient have failed.

Case Reports

The following are case reports on operations performed at Drake Hospital:

Case 1. M.H., a 59 year old colored female, developed recurrent metastatic symptoms four years after a radical mastectomy had been performed. Prior to the second admission to the hospital, the patient had been maintained on testosterone for one year. Surgery was then considered because of severe shoulder pain. A physical examination revealed remarkable weight loss, anorexia, weakness, and an old anterior myocardial infarct—compensated with digitalis. The patient required 75 mg. Demerol q4h. A bilateral oophorectomy was performed and tolerated well. Two months later a bilateral adrenalectomy was done: also tolerated well with an uneventful recovery. After ten days, postoperative administration of Demerol was no longer required, with one-half grain of codeine re-

quired for only a short period. At this writing, one year later, only five grains of aspirin are required occasionally for relief of pain in the arms, legs and shoulder. The patient is gaining weight, and goes home frequently on pass for several days at a time.

Case 2. R.B., a 52 year old white female, developed pain in the arms and legs, with large painless metastatic nodules of the head and face and hemiplegia of the left side, two years following a radical mastectomy. She was successfully treated with X-ray therapy, testosterone, thorazine and opiates for nearly two years. She was then admitted for surgery because of severe pain; weight loss of sixty pounds, nausea and vomiting. Medication requirements were: Dilaudid grs. 1/32, Pantopon grs. 1/3, Demerol 100 mg. alternating q4h, Thorazine 50 mg. twice daily, and a barbiturate —grs. 1½ at bedtime. A bilateral oophorectomy and right adrenalectomy were performed, which was four years following the radical mastectomy. Thirty-six hours after the operation the patient developed a pulmonary embolus, but the EKG was normal. The patient responded to emergency treatment, and staged an otherwise uneventful recovery. Two months later the other adrenal gland was removed, with the patient tolerating the precedure well. Opiates were only required for the immediate postoperative period, and at the end of two weeks following the last surgery, all opiates were discontinued. The patient's appetite has improved with resulting normal weight gain. She takes aspirin occasionally for headache, and goes home frequently on pass for several days. The patient's last operation was approximately two years ago.

Case 3. M.D., a 51 year old female, was admitted for adrenal surgery one and a half years following a mastectomy for poorly differentiated adeno-carcinoma. Despite X-ray and testosterone therapy, the patient had been bedfast, because of severe pain, for one year. Due to extensive metastasis, the initial procedure had not been radical as had been contemplated. At this time, the patient was taking 1/3 gr. Pantopon, 1/4 gr. morphine, and 10 mg. methadon, alternating every two hours, as well as barbiturates for sleep. The patient had attempted suicide one week prior to surgery and a psychiatrist diagnosed the patient as a hysterical masochistic who exaggerated her feeling of severe pain. Physical examination revealed the patient had marked weight loss, essential hypertension of 220/130, pulse 100, and an old myocardial injury. A bilateral adrenalectomy was done at this time since an oophorectomy had been performed in 1930. Narcotics were administered for postoperative pain for one month with marked relief. The patient was discharged four months later, taking morphine grs. 1/4 q3-4h, and seconal at bedtime. The patient was still bedfast because of severe compression of D-12 from metastasis. Prior to surgery she had been taking opiates q2h. The pathology report revealed a poorly differentiated adeno-carcinoma which does not respond favorably to removal of the adrenal glands. The patient states her pain is now about one-fourth as severe as it had been prior to the adrenal surgery, which was two years ago.

The above cases are outlined so that you may more clearly understand the physical status of the patients and the reason for radical

surgery. It is vitally important to maintain a light plane of anesthesia, which is usually very well tolerated. All have been handled very similarly as is self-explanatory from the following——

Twenty-four hours prior to surgery, the patient is placed on 50 mg. of Cortisone q6h I.M., Aq. Penicillin 300,000 U q4h. One dose of NaCl 4 gm. is given 18 hours preoperatively. Seconal 1½ gr. is given at bedtime, and repeated if necessary. The following A.M., Cortisone 100 mg. I.M. is administered 1½ hours before surgery and at the same time a barbiturate which is usually sodium luminal 2 gr. by hypo. Demerol 50-100 mg. and atropine 1/150 gr. to 1/100 gr. is administered one hour before surgery. A cut down with a 15 gauge needle is done in surgery and 1000 cc. of 5 per cent glucose in water is started slowly. Another intravenous is started in the vein of the arm with the same solution.

Four of the six cases operated had pulse and blood pressure ranges within normal limits, which varied slightly on arrival in surgery. The other two cases had increased pulse rates of 30-40 beats per minute which persisted throughout anesthesia. The one hypertensive had a blood pressure reading 50 mm. systolic lower than her normal reading.

All cases are inducted very slowly with two and one-half per cent Sodium Pentothal until the lid reflex is abolished, which usually requires about 10-15 cc. (Gas was administered to the first five patients with GOE started, using the closed system.) One to two cc. of Mecostrin are given intravenously soon after induction for intubation.

On the sixth patient, following induction, a trans-tracheal block was done with 3 cc. of 5 per cent Cyclaine solution for intubation. There are two advantages in this method: (1) the patient requires much less anesthesia to tolerate the tube and (2) the need of any curare preparation is eliminated. The patient is placed in one of two positions—lateral or prone, with no appreciable change in blood pressure and pulse. Course of anesthesia does not differ from other cases until the second adrenal gland is removed. At this point the blood pressure may drop to a dangerous level very rapidly, and readings must be taken almost constantly. With a drop of 10 mm. systolic, Levophed drip of 4 cc. to 1000 cc. of 5 per cent glucose in water is started immediately and rate of flow determined to maintain blood pressure at 10-20 mm. below preanesthetic systolic reading on arrival in surgery.

Two of the cases required no Levophed. One of these survived; the other lived 14 hours. The other four required Levophed 2-4 days following surgery in dosages from 8 cc. in 1000 cc. of glucose in water. One of these four, suffering from extensive kidney and heart damage, expired 52 hours postoperatively while still on Levophed. Anesthetic time runs from 1½ to 2 hours from induction to extubation. Blood loss is replaced and usually one unit is all that is required. These patients require special nursing care for constant supervision of blood pressure control, accurate intake and output, as well as routine postoperative care.

On the most recent cases, when surgery was begun, 1000 cc. 5 per cent glucose in water containing 100 mg. hydrocortisone was started in-

travenously at a slow rate. The flow was regulated as needed to elevate blood pressure. This has proven very satisfactory and has eliminated the need for Levophed or any vasopressor.

The following case reports cover three unsuccessful bilateral adrenalectomies performed at Drake Memorial:

Case 4. The preoperative history of M. B., a 36 year old white female, was similar to the other cases previously outlined as to the metastasis, but in addition, the physical examination revealed a pleural effusion, habitual cough, dyspnea, ascites, jaundice, enlarged spleen and liver, and pitting edema. The patient tolerated the bilateral adrenalectomy and anesthetic remarkably well, and was returned to her room two hours after induction. However, respiration became increasingly labored with minimal urinary output. Blood pressure was maintained near normal with Levophed, but the patient expired 52 hours later. An autopsy revealed uremia, acute heart failure, pulmonary edema, carcinoma of the right breast with widespread metastasis, bronchopneumonia and status post-bilateral adrenalectomy.

Case 5. The preoperative history of M. K., a 55 year old white female, was also similar to the previous cases cited, plus Jacksonianlike convulsions and marked exophthalmus. Upon arrival in the operating room the patient was extremely apprehensive and crying, stating she would never survive surgery and she had made no arrangements for an autopsy. A bilateral adrenalectomy with application of dressing was completed when the patient, still in prone position, suffered a cardiac arrest without respiratory arrest. Cardiac massage was instituted and defibrillator applied. Cardiac status responded satisfactorily, but the patient did not regain consciousness and had marked rigidity when returned to her room three hours later. She developed convulsions five hours later followed by four more attacks. The patient died fourteen hours after return to her room. The cause of death was diagnosed as cerebral anoxia and cardiac arrest.

Case 6. B.C., a 56 year old white female, progressed favorably following a bilateral adrenalectomy until 23 days postoperatively she developed a pleural effusion, with pulmonary edema and cardiac decompensation. Physical examination revealed jaundice, severe epistaxis, oliguria followed by anuria, and general shock symptoms. The patient did not respond to treatment, and died two days later. Autopsy revealed metastasis to the liver with complete damage.

Inadequate sodium and cortisone therapy following adrenalectomies produces weakness, loss of sense of well being, and anorexia. The patient develops water intoxication with resulting anuria as the urinary sodium and chloride excretion diminishes. Therefore, patients are maintained on 25-50 mg. of Cortisone daily for the rest of their lives, with supplemental NaCl if the patient has less than 80 meq/1 of chloride where normal is considered to be 100-105 meq/1. Our patients have received 250 cc. glucose in normal saline intravenously for three days postoperatively followed by oral NaCl the next two days, and are then placed on a regular diet.

Conclusion

In concluding, the following summarizes our experience in anesthesia

(Continued on page 222)

Clinical Observations on the use of Vinamar®

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Ethyl vinyl ether, recently released for general use as Vinamar®, is an asymmetrical unsaturated ether with a chemical structure intermediate between divinyl ether and diethyl ether. Its chemical, physical, and pharmacological properties lie somewhere between the two parent molecules. It is a colorless, volatile liquid with a pungent odor resembling divinyl ether. Precautions to prevent deterioration similar to those for the other ethers should be taken. It is claimed that Vinamar® is stable if kept tightly stoppered when not in use.

Laboratory tests performed by early workers with ethyl vinyl ether[1,2] showed no permanent liver damage following repeated administrations. No significant change in the blood picture was noted. Transitory acetonuria was present on several occasions following large doses of ethyl vinyl ether. Electrocardiographic tracings showed a downward displacement of the pacemaker following high dosage. This was reversible in all cases, and not more frequent than with other anesthetic agents. There was no adverse effect on cardiac automaticity.

Dornette and Orth[3] reported generalized convulsions in three cases with ethyl vinyl ether. They felt that this complication was associated with hypercarbia and could be prevented by a small flow of oxygen under the mask.

Such laboratory tests were not repeated by us, but an attempt was made to evaluate the usefulness of the drug clinically.

Vinamar® was administered to sixty patients; the youngest five and one-half weeks of age, and the oldest forty years of age.

Age of patient	No. of cases
Under 2 years	9
2-6 years	28
7-14 years	19
15-40 years	4

Table 1

In five cases Vinamar® was the sole anesthetic agent used; in two cases it was used endotracheally with cyclopropane in the closed circle system; two cases were intubated with Pentothal® succinylcholine and maintained with nitrous oxide-Vinamar® by the semi-closed method; one case received nitrous oxide-Vinamar® by

*St. Vincent's Charity Hospital, Cleveland, Ohio.
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the semi-closed method. In the remaining fifty cases Vinamar® was used as an induction agent preliminary to diethyl ether anesthesia. (Table 2)

These patients were from the surgical services represented in Table 3.

Intubation by direct vision was accomplished in two cases with cyclopropane and Vinamar®. Jaw relaxation was only fair, but cord relaxation was good, and no "bucking" occurred.

ity of cases, and when present was less pronounced than with divinyl ether: *Vinamar® being less volatile, an excessive concentration does not build up under the mask;* (5) excessive salivation was not present in adequately premedicated patients; (6) transition to diethyl ether was smoother than with divinyl ether; since emergence is slower more time is available to reach saturation with ether, and the time required to reach Stage III, Plane 1, seemed to be shorter.

Combination of drugs	No. of cases
Vinamar® only	5
Cyclopropane-Vinamar®	2
Pentothal-succinylcholine-N_2O-Vinamar®	2
N_2O-Vinamar®	1
Diethyl ether-Vinamar®	50

Table 2

Vinamar® was used as the sole anesthetic agent in four ambulatory patients for short procedures. Anesthesia was satisfactory and emergence was rapid without delirium, nausea, or vomiting.

When using Vinamar® by the open drop method a slow but constant drop was started with the mask held away from the patient's face. As the mask was lowered, a flow of 2-3 liters of oxygen was started under the mask.

The following observations were made on the use of Vinamar® as an induction agent prior to maintenance with diethyl ether: (1) induction was slightly longer than with divinyl ether but not unduly prolonged; (2) the odor though quite pungent was not objectionable to most patients; (3) the vapor did not cause coughing or bronchial irritation; (4) breath-holding was not a problem in the major-

Complications encountered were: (1) breath-holding without cyanosis in two cases; (2) sneezing in two cases; and (3) stridor on two occasions which was relieved by decreasing the concentration of vapor. Also, one 7 year old child with severe mental deficiency exhibited "running movements" of the arms and hands, but no generalized convulsion. This child was uncooperative and crying, and it was felt that the anesthetic may have been pushed too fast. A two-liter flow of oxygen under the mask, and a slowing of the drop, re-

Surgical Service	No. of patients
E.N.T.	42
Eye	1
General surgery	6
Orthopedic	3
Plastic	8

Table 3

sulted in prompt cessation of the movements.

Case Report

A 40 year old white male, 6 feet 4 inches tall, weight 210 pounds, was admitted for a tonsillectomy. Physical findings were negative except for chronically infected tonsils. Hemoglobin was 15.2 Gm.; urine negative; blood pressure 130/78. The patient refused local anesthesia. Premedication consisted of Nembutal grs. 1½, Demerol 100 mg. and Atropine grs. 1/150——one hour preoperatively.

Anesthesia was induced with Pentothal 2% solution and succinylcholine 0.1% drip was started. Blind nasal intubation was performed without difficulty and nitrous oxide-oxygen 4:2 liters started by the semi-closed method. The intravenous anesthetic agents were discontinued: a total of 400 mg. of Pentothal and 50 mg. of succinylcholine having been used. Vinamar® was added by vaporizer and the patient maintained on nitrous oxide-oxygen-Vinamar®. Operation was started 7 minutes after the beginning of anesthesia. Throat reflexes were obtunded and respirations were spontaneous and full throughout the 35 minute precedure. A total of 20 cc. of Vinamar® was vaporized during this time.

Five minutes after the anesthetic was discontinued the cough reflex was active and the patient was extubated. Three minutes following extubation the patient was completely reacted with no emergence delirium, no nausea or vomiting, and was answering questions rationally.

Conclusion

Summary of ethyl vinyl ether, Vinamar®, used clinically in sixty patients for induction of general anesthesia, and as a supplement with other anesthetic agents——

(1) Induction was smooth and emergence not prolonged.

(2) Excessive salivation was not a problem in adequately premedicated patients.

(3) Vinamar® is compatible with other anesthetic agents and with soda lime.

(4) Breath holding was infrequent and not troublesome when it occurred.

(5) Convulsions could be prevented by the use of oxygen and by not pushing anesthetic agent.

From our clinical experience in this series of cases it would seem that Vinamar®** is a satisfactory agent for induction and for reinforcing other anesthetic agents.

**Vinamar® used in these cases was supplied by the Ohio Chemical Company.

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Hypotensive Anesthesia

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In the last few years anesthetists have been called upon to produce a state known as induced hypotension. The object in hypotensive anesthesia is to interrupt the normal vasomotor control of the vascular system and induce a lowered blood pressure. This hypotension is utilized when it is necessary to reduce blood loss to conserve the patient's blood, reduce the tension in large vessels that are to be operated upon, to provide a clear field unobstructed by blood, and to reduce brain edema.

As we all know, blood pressure depends upon cardiac output, peripheral resistance, blood volume, blood viscosity and vessel elasticity. Blood pressure is reduced by causing a discrepancy between the circulating blood volume and the vascular tree.

The dangers of hypotension are the result of low blood pressure on the different body systems; therefore, induced hypotension should not be employed in patients with severe arteriosclerosis, uncorrected anemia, hypovolemia, severe vascular disease, shock, asphyxia or any condition where there may be inadequate coronary or cerebral circulation. Inadequate availability of fluids and inability to replace blood for technical reasons may also constitute contraindications.

In making certain that induced hypotension is to be safe, limitations must be put on both the level and duration of hypotension. The period of hypotension should be as brief as possible, not to exceed 90 minutes. At least 60 millimeters of mercury pressure is necessary to maintain adequate circulation to the kidney. Usually the blood pressure is maintained between 60 to 80 millimeters of mercury. It is well to remember that this technique controls only the ooze and not the bleeding from major vessels. Blood must be replaced as lost, otherwise irreversible shock may occur. Little anesthetic is required during the period of hypotension, and the depth of anesthesia is not as great as that which is required without hypotension.

Hypotension is induced by one of three methods: arteriotomy, high spinal, or the use of ganglioplegic drugs.

Arteriotomy

Arteriotomy is a technique of blood withdrawal and replacement. Briefly, this procedure consists essentially of the withdrawal of blood from an artery until the desired level of hypotension is reached; the maintenance of this required level by periodic reinfusions and withdrawals; and the ultimate restoration to normal pressure by replacement. This technique requires elaborate preparation, execu-

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tion must approach perfection because even a minor technical failure which is not promptly corrected may result in disaster. It must be remembered that, as in simple blood loss, peripheral vasoconstriction will exist and therefore blood pressure cannot be lowered with safety to the same extent as is possible when vasodilatation exists. Frequently, when this technique is employed, it has been noted that all the blood withdrawn cannot be replaced. This is explained by the fact that the generalized vasoconstriction which occurs from the hemorrhage has caused the vascular bed to shrink in size. With this technique the blood pressure should not be allowed to fall below 80 millimeters of mercury.

High Spinal

With the high spinal technique the blood pressure is lowered as a result of peripheral vasodilatation which occurs as the sympathetic vasomotor fibers are blocked by spinal anesthesia. The vasomotor outflow leaves the spinal cord by way of all the thoracic and the first two lumbar anterior roots. Therefore, the higher the anesthetic level is carried, the more extensive will be the sympathetic paralysis and the resulting fall in blood pressure. Blocking above the first thoracic segments affords no further advantage and is undesirable because respiratory paralysis may occur. Preparation must be made to assist or maintain ventilation in case this occurs.

To accomplish this procedure, a continuous spinal catheter is inserted within the subarachnoid space and 100 or 150 milligrams of procaine are injected through it. Ordinarily, this will provide adequate anesthesia in the field of surgery and produce a satisfactory drop in blood pressure. If necessary, repeated injections of procaine may be given.

The reflexes which ordinarily initiate vasomotor control with changes in posture are abolished. Care should be exercised not to elevate or lower the head excessively.

Bloodless operative fields can be attained, but this procedure also requires careful preparation and execution and is not entirely controllable or safe.

Ganglionic Blocking

The chief use of induced hypotension is for situations in which considerable bleeding is anticipated. To date, the most satisfactory method of producing the controlled hypotensive state is with the autonomic ganglionic blocking agents.

The pharmacological effects of hexamethonium bromide, or C-6, are the result of its potent blocking of synaptic transmissions in autonomic ganglia. The ganglionic cell is not depolarized; the blockade which it produces results solely from the elevation of the threshold of the ganglionic cell to acetylcholine liberated by the preganglionic nerve volley. It resembles d-tubocurare in its action on ganglia.

Cardiac output is often reduced by hexamethonium in patients with cardiac compensation, but it is frequently increased in those with cardiac failure. The peripheral blood flow and pulse volume increases, especially in the lower extremities.

The technique most commonly used is to administer a general anesthetic in the usual manner. At the appropriate time, doses of hexamethonium are injected intravenously to reduce the blood pressure to the desired

level. The average level of systolic blood pressure for maintenance is at 70 millimeters of mercury. Careful attention must be given to the dosage, as it varies widely, and the effect is, to some extent, unpredictable. The young patients and those requiring excessive drugs for anesthesia are more apt to require larger doses. From 12.5 to 25 milligrams may be tried initially and additional amounts given fractionally, depending upon the response. There appears to be a tendency to develop a tolerance, so an effective initial dose is desirable.

At the completion of surgery, the blood pressure is returned to normal by the use of vasopressors and intravenous fluids. Even though the effects of this drug last several hours following surgery, it provides greater controllability than does high spinal anesthesia or arteriotomy.

In 1951, a new autonomic ganglionic blocking drug, known as Arfonad, was introduced. Arfonad blocks transmissions through the superior cervical ganglion, vagus action on the heart, and carotid sinus pressor reflex. It is primarily a ganglionic blocking agent, but there may be a direct peripheral vasodilator effect. By inducing vasodilatation it causes pooling of blood in the dependent periphery and the splanchnic system. The vasodilatation results in a lowering of the blood pressure. It is possible to employ the drug by continuous intravenous infusion. In this manner variable and graded fluctuations of the blood pressure can be provided, thus achieving minute-to-minute control of both the degree and the duration of the hypotension. This controllability is of important value in that it allows the rapid termination of the hypotensive state at the end of surgery, or the rapid abandonment of the technique in the face of uncontrollable hemorrhage or similar surgical emergency.

Arfonad is given in a 0.1 per cent solution. The desired level of anesthesia is established and the surgical procedure started. Approximately ten minutes before the level of hypotension is needed the intravenous drip with Arfonad is started at the rate of 60 drops per minute. The rate of administration is then adjusted to maintain the desired level of hypotension. Since there is a marked variation in individual response, frequent blood pressure determinations are essential to maintain proper control. Rates as low as 4 drops per minute to rates exceeding 100 drops per minute have been found necessary.

Arfonad should be stopped prior to wound closure in order to permit the blood pressure to return to normal. A systolic pressure of 100 millimeters of mercury will usually be attained within ten minutes. Epinephrine, norepinephrine and ephedrine act promptly to reverse the hypotension due to Arfonad.

Hypotension Complications

Regardless of the technique chosen to produce hypotension it is essential that the blood pressure be returned to normal before the incision is closed so that all bleeders can be properly controlled. This may be accomplished by the reinjection of the blood withdrawn in arteriotomy, or by the use of vasopressors with the high spinal, hexamethonium or Arfonad techniques; however, with the latter, vasopressors are seldom needed.

It is of utmost importance that the blood loss be estimated accurately and replaced as needed. It is well to

(Continued on page 222)

Legal Aspects Pertaining to Anesthesia and the Nurse Anesthetist

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It is elemental that every person is entitled to safety from injury to his person or his property by the intentional wrongful acts of another, or by the unintentional negligent acts of another. Although legally, an automobile is not classified as a dangerous instrumentality in and of itself, the use of an automobile often causes considerable damage. We all know that whenever we drive an automobile, we may injure another person or damage the property of others and, thereby, become the defendant in a law suit. We, therefore, carry insurance and attempt to exercise care in the operation of our automobiles.

The Lawyer

Each profession, which performs services to the members of the public, has its own peculiar risks and duties not shared by other professions. A lawyer who undertakes to represent a client has a duty to perform toward that client, and if he breaches that duty and the client sustains injury or damages, he must respond and compensate the client for that mistake. For example, I cite the case of Schirmer v. Nethercutt, 157 Wash. 172, 288 Pac. 265. The facts of that case are relatively simple, and it stands as a landmark case in the State of Washington, pointing out to lawyers the responsibilities which they assume in representing and performing services for their clients. In that case, a lawyer prepared a will for an elderly lady——the will providing that her grandson, who incidentally was studying law in the lawyer's office, would receive one-half of her estate. The will apparently was properly drafted. However, when the lawyer had the grandmother sign the will, he witnessed it and had it witnessed by the grandson who was to share in the estate. After the grandmother died, the will was challenged because it had been signed by the grandson who was a beneficiary. The courts determined that the will was valid, but that under the circumstances the grandson was disqualified from receiving any part of the estate. The grandson thereupon sued the lawyer for breach of duty and recovered judgment against the attorney for the value of the property which he would have received from his grandmother's estate had the will been properly executed.

The Doctor

Physicians and surgeons, in the treatment of their patients, are also

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faced with situations that carry legal implications. Of course, the mere fact that treatment is unsuccessful does not mean that the doctor is legally obligated to respond in damages. Recently, the Washington Supreme Court decided a case known as Skodje v. Hardy, 147 Washington Decision 498. The doctor in that case examined a patient and diagnosed a bowel infection. It later turned out that the patient was suffering from acute appendicitis and the doctor was named as a defendant in a law suit. However, the Supreme Court said that a wrong diagnosis is not actionable unless it is the result of negligence or is followed by improper treatment to the injury of the patient. In that case, the patient did not prove that the doctor's failure to correctly diagnose the case was due to the fact that he failed to use the care, skill, and diligence ordinarily possessed and exercised by members of the medical profession in his community.

The Nurse Anesthetist

Nurse Anesthetists in the performance of their duties, encounter situations which have legal aspects. Before citing a particular case which was recently decided by the Supreme Court of the State of Washington, I would like to point out that the science of law, that is jurisprudence, is not an exact science and is not static. Lawyers deal with facts and in order to establish facts, they must present testimony of witnesses in court and the variation in testimony of witnesses from case to case, may change the ultimate result which is reached by the jury or by the court. I can not dogmatically say that the law is thus or the law is so. Each time the Supreme Court renders an opinion it may either establish new law or may modify what many lawyers have thought to be the law.

The case of Kemalyan v. Henderson, 45 Wn., (2d) 693, 277 P., (2d) 372 is of particular interest to nurse anesthetists. Mrs. Kemalyan, the plaintiff in the case to which I refer, was herself a registered nurse who entered a Spokane hospital for a surgical operation in which her tonsils were to be removed. The surgeon who was to conduct the operation arranged for the use of an operating room at the hospital and requested the hospital to provide an anesthetist to administer a general anesthetic because Mrs. Kemalyan was allergic to novocaine and could not be given novocaine as a local anesthetic. The nurse anesthetist furnished by the hospital had 23 years' experience and had been employed at that hospital for 20 years. The doctor, who was to perform the surgery, considered her to be a well-trained and qualified anesthetist. The doctor identified his patient to the anesthetist and left the operating room to go to the scrub room. While he was out of the operating room the nurse commenced to administer the anesthetic. In the performance of her duties she used a nasal catheter which was the usual and normal procedure in such operations. When the doctor returned to the operating room he seated himself on a small stool and waited for the nurse to tell him that the patient was ready to be operated upon. When the nurse signified that the patient was ready, the doctor rose and picked up a mouth gag. At that point, the nurse decided that the patient was not sufficiently anesthetized and she so advised the doctor, suggesting that the patient needed more anesthetic. The doctor reseated himself while the nurse anesthetist administered an ad-

ditional anesthetic. She then noticed, that the patient's abdomen was distended. She called that fact to the attention of the doctor and discontinued the anesthesia. The tonsillectomy was not performed and the patient was removed from the operating room. X-rays later disclosed that free air and gas had penetrated her stomach or intestinal organs and collected in the abdominal cavity. The patient brought a law suit against the doctor and against the hospital for the injuries which she had sustained, but she did not name the nurse anesthetist who administered the anesthetic as a defendant in the action. I mention this fact because the lawyer for the injured patient might and could have named the nurse anesthetist as a party defendant along with the doctor and the hospital.

When the case was tried, the jury returned a verdict for the patient against the hospital but not against the surgeon. The hospital contended unsuccessfully that the nurse anesthetist furnished by it was the special servant of the surgeon who had the power of immediate direction and control of her activities and that, therefore, the doctor should have been liable rather than the hospital. However, there was testimony of a number of doctors to the effect that it was the custom in Spokane hospitals for the surgeons to rely entirely upon the nurse anesthetist in the giving of an anesthetic. The jury to which the case was presented apparently believed that testimony and, therefore, concluded that the nurse anesthetist was the servant of the hospital rather than the surgeon.

If there had been no testimony that surgeons in that community customarily relied entirely upon the nurse in the giving of the anesthetic, the jury might well have brought in a verdict against the doctor rather than the hospital. Furthermore, if the surgeon had been giving directions to the nurse anesthetist, exercising control over her activities, the jury might have found him to be liable rather than the hospital.

Generally speaking, the nurse anesthetist has two masters: the hospital, whose duty to the patient requires the hospital to furnish a well-trained anesthetist with proper equipment; and the other, the surgeon whom the nurse anesthetist assists in the operation. As I have said, the science of jurisprudence is not an exact science and results in law suits that vary according to the testimony which is introduced in court. Consequently, in future cases in this jurisdiction, there will undoubtedly be times when the operating surgeon will be held liable for injuries sustained by the patient as a result of the manner in which the anesthetic is administered by the nurse anesthetist, and there will be cases where the hospital may be held liable for the manner in which the anesthesia is administered. Furthermore, there may be cases in which the nurse anesthetist is named as a defendant and may be required to respond in the payment of damages.

In the *Kemalyan* case, it was not established just how the injury to the patient occurred. There was some testimony to the effect that the nasal catheter may have been allowed to slip part way into the esophagus instead of remaining up in the pharynx. *Something* went wrong during the administration of the anesthetic by the nurse anesthetist, and the hospital was unable to produce evidence which would satisfy the jury that the administration of the anes-

thetic was not done in a negligent manner.

It may seem that I have struck a pessimistic note, and that I have indicated that nurse anesthetists should and will be subject to law suits. I caution that this one particular case, the *Kemalyan* case, in which the nurse anesthetist was not named as a party defendant, should not be accepted by nurse anesthetists as any indication that in a given situation, either the doctor or the hospital would be liable in damages. I have already pointed out that the nurse anesthetist in that case was not even named as a defendant. The nurse anesthetist had many years of experience, and the doctor testified that she knew considerably more about administering an anesthetic than he did. If we are to draw a moral from this case, we might say that this is a day of specialists, and that the jury, in relieving the doctor in that case from responsibility for the patient's injuries, believed that the nurse anesthetist was more skilled in the administering of anesthetic than was the doctor, and he was, therefore, justified in relying completely on her discretion.

In my opinion, this case highlights the demanding nature of the nurse anesthetist's work, and the skill, alertness, and constant attention to details which is expected of the nurse anesthetist in her profession.

Succinylcholine Chloride

Joyce Fallin, R.N. *
Fort Worth, Texas

Anesthetists have long been desirous of providing a means of adequate and controllable skeletal muscle relaxation during certain surgical procedures. With the advent of muscular relaxant drugs, much progress has been made through the work of the pharmacologist, the physiologist and the anesthesiologist. The discovery of one agent has proved to be an encouraging step for further discoveries of others, which is indicative of seeking the ideal—that which will not cause physiologic changes of vital organs. Thus each step has been one of advancement.

It is my purpose to present a brief history of the progress resulting from these endeavors; the pharmacologic action, techniques, clinical uses, advantages and disadvantages of succinylcholine chloride.

Pharmacologic Action

Succinylcholine, or diacetylcholine, was first marketed in this country under the name of Anectine. In 1949 and 1950 there appeared reports by Bovet, Castillo and de Beer, Walker and Phillips concerning this drug. However, before this time Hunt and Traveau, in 1911, reported on the pharmacological properties of choline and its derivatives, succinylcholine being one.[1]

Many years after this discovery, Loewin demonstrated the action of neuromuscular transmission. Glick, in 1941, found that cholinesterases hydrolyze these compounds, breaking them down into succinic acid and choline——both normal metabolites of the body.

This suggested that detoxification was not dependent on the slower processes, i.e., by the liver, kidneys and elimination by the lungs.[2]

The action of d-tubo-curarine was earlier established to be primarily that of blocking impulses at the myoneural junction. With succinylcholine, the action occurs at the end plate by depolarization. Briefly reviewing the mechanisms of neuromuscular transmission, we learn that at the junction of a muscle and its motor nerve lies a membrane. On either side of this membrane, there is a balance of electrical energy. This membrane is "polarized" when in a resting state, that is, it is ready to function. With stimulation to this membrane, acetylcholine is liberated and the balance of electrical energy becomes deranged. Depolarization occurs and the muscular contraction is followed by relaxation. Acetylcholine is destroyed by the enzyme, cholinesterase, and understandably, repolarization occurs, and the muscle regains its normal tone. If there remains an excess of acetylcholine or, if it is not

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Read at the Annual Meeting of the Texas Association of Nurse Anesthetists, Dallas, Texas, April 5, 1956.

destroyed, the muscle does not respond to further stimulation, and depolarization and neuromuscular blockade takes place. It is believed that succinylcholine acts in this manner. Whatever the mechanism may be, it is established that its action is entirely different from d-tubo-curarine, although the end results are similar.[3,4]

I mentioned cholinesterase, the enzyme responsible for the destruction of acetylcholine. Since there are many cholinesterases in the body, the "true" cholinesterase is identified as this one, and it is found principally in the red blood cells. The others are pseudocholinesterases and are constituents of the blood plasma. These enzymes serve in the hydrolysis of succinylcholine into succinic acid and choline. These enzymatic proteins are contained in the tissues, and there are variations of normal values. Certain illnesses may alter the normal in an individual, e.g., debilitation, liver disease, anemia, malnutrition, and poisoning by anticholinesterase insecticides. With a decreased pseudocholinesterase level, the action of succinylcholine chloride will be prolonged and intensified. It is believed that the administration of fresh blood or plasma will aid in restoring cholinesterase activity. This is the accepted treatment since cholinesterase inhibitors such as neostigmine or prostigmine and tensilon chloride, which are antagonists of d-tubo-curarine, are *not antagonists* and *actually intensify* the action of succinylcholine.[5] The drug should be employed cautiously or not at all with patients who might have low levels of pseudocholinesterase. Those individuals who present themselves with lowered blood volume from hemorrhage, may be suspected of lowered levels of pseudocholinesterase. It has also been noted that patients suffering from electrolyte imbalance, such as may occur in intestinal obstruction, are unusually sensitive to succinylcholine. The controllability of a dilute solution will aid in this determination. The anesthetist must be constantly on the alert for the progressively diminished respiratory activity, and reduce the rate of flow or discontinue the administration before prolonged apnea occurs.

It has been reported that along with the lowered plasma cholinesterase activity, should urine formation also be decreased, the postanesthesia depression will be extemely prolonged. Tests of the fate of succinylcholine in man made by Drs. Foldes, Vandervort, and Shanar, revealed that an average of less than three per cent is excreted unchanged in the urine of surgical patients. This obtained data can guide the administration more carefully.[6]

Administration

The techniques of administration include the fractional and continuous drip methods. Adequate muscular relaxation can be obtained with either method within 15 to 90 seconds. The use of single intravenous injections of 10 mg. to 40 mg. will produce complete relaxation lasting from three to four minutes. This is suitable for endotracheal intubation, electroconvulsive treatment, laryngospasm, and other instances which demand only short periods of relaxation. For the longer cases the continuous method is especially advantageous in assessing the patient's needs for the particular operative procedure, and provides a minute to minute control of muscular activity. In other words, one allows the patient to titrate the

amount of succinylcholine he requires. This is accomplished by the administration of a dilute solution of one per cent or two per cent succinylcholine in saline or dextrose in water. Normal respiratory activity and muscular tone are restored within five minutes following the discontinuance of administration. The dosage and strength of solution can be varied by the demands of fluid therapy in the continuous method. If circumstances are such that restricted fluid therapy is mandatory, the more concentrated solution can be administered.

When the neuromuscular blockade occurs, the effect on respiration is depressed activity which can seriously impair pulmonary function. The first and primary consideration must be to maintain proper ventilation. This is accomplished by compensated or controlled respiration if complete apnea has occurred. Unless the apneic technique is desired, the drip should be adjusted to allow some degree of spontaneous respiration. It is imperative that a knowledge of the psysiology of respiratory functions be understood and that the importance of immediate and adequate assistance of depressed respiratory activity be emphasized. The complications of inadequate and improper ventilation may be manifested by signs of hypercarbia and hypoxia. Studies have shown that hypoxia and carbon dioxide excess may be the responsible factors in the production of cerebral edema following surgery, which result in prolonged recovery time, dysphoria, nausea and vomiting, etc. Atelectasis and other pulmonary complications may also result from inadequate ventilation. These can be avoided by proper assistance of respiration through a clear airway. No fixed value can be placed on the amount of inspiratory pressure, since this will vary with lung compliance.

Except for the disturbance in respiratory function, succinylcholine is relatively free from deleterious effects on the other body systems. The most common side effect is the muscle fasciculation which sometimes precedes the onset of relaxation.[7] Usually this phenomenon is seen when the drug is injected rapidly and in undiluted form. Rapid injection should, therefore, be avoided in patients with fractures or dislocations.

There is no direct effect on the heart or central nervous system. A moderate hypertension is occasionally noted during the administration of large doses of succinylcholine. Since the pharmacological actions of the drug are almost identical to those of acetylcholine, it is thought that this hypertension represents a nicotine-like action on the sympathetic ganglion cells and vasomotor center.

Peristalsis remains normal or becomes slightly hyperactive and there is no increased incidence of vomiting. The drug does not interfere with metabolism, and there are no adverse effects on the liver, kidneys, or spleen.

Clinical Uses

Succinylcholine has been used effectively in all types of operative procedures, including abdominal, thoracic and neurological surgery. Its use in endotracheal intubation, electroconvulsive therapy and other short diagnostic and therapeutic procedures has already been mentioned. Its relaxing qualities have proved useful for the terminal stage of delivery, and it is probably the agent of choice for the complete flaccidity necessary to perform internal podalic version, rotation of posterior presentations,

manual removal of placentae, etc. Although it would appear that succinylcholine passes through the placental barrier, its action is so short-lived that it offers no great problem in the resuscitation of the infant.[8]

The agent may be used in combination with any of the inhalation or intravenous anesthetics. Unlike curare, it is not synergistic with ether, although clinically, it does seem that less of the relaxant is required when ether is the anesthetic.[9] As with any of the muscle relaxants, it must be recognized that succinylcholine does not in itself produce anesthesia. Too light a plane manifests itself by increased lung compliance and even moderate bronchospasm, which indicates the need for additional anesthesia. Even so, first plane anesthesia is usually adequate when succinylcholine is producing the relaxation. Most of our patients are awake or reacting during their move to the recovery room.

Conclusion

To summarize: we believe that succinylcholine is the best of the present-day muscle relaxants, having few unwanted side effects while producing a maximum of relaxation. As long as one is familiar with its mechanism of action, and can efficiently cope with the problem of depressed respiratory activity, the agent is a safe and valuable addition to the anesthetist's armamentarium.

I wish to acknowledge the assistance of our Anesthesiologist, Dr. A. N. Heinrichs, Harris Hospital, Fort Worth, Texas. His suggestions and criticisms were deeply appreciated in preparing this paper.

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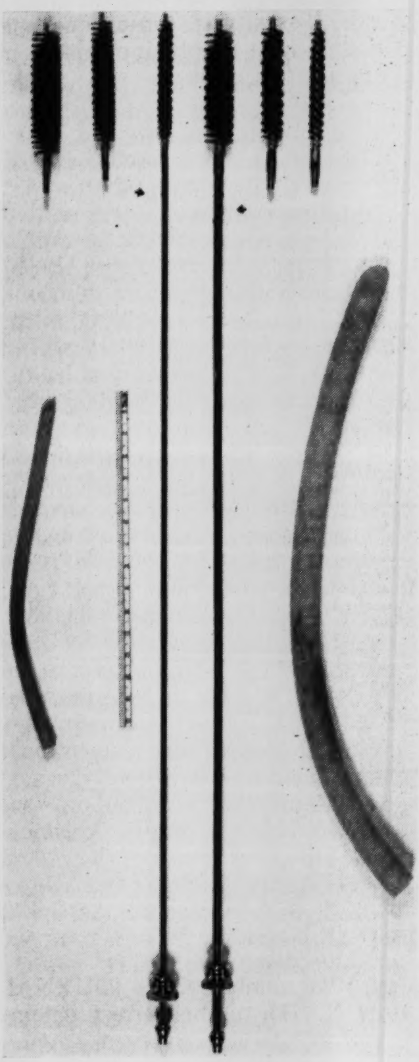
ERROR!

The volume number on the cover of the May, 1956 number of the JOURNAL is incorrect. Please change the number from XXIII to the correct volume number XXIV.

Notes and Case Reports



Tube Cleaning Set

This is a picture of a #10 Portex catheter, an adult endotracheal catheter cleaning set, a pediatric cleaning set, and a #2 catheter. The handles are rigid tubes and a water hose can be attached to the base of the handle, the point of egress of the water is behind the brush (marked by arrows in the photograph). Each handle is provided with three nylon brushes of different sizes so the brush can be fitted to the endotracheal catheter. The nylon bristles are permanently attached and have not loosened in over a year of hard usage. The adult set will clean any adult tube; the pediatric set will handle down to a #2 tube. A longer set is available for bronchoscopes.

The sets were designed by Dr. John Stetson of the University of Michigan and are manufactured by the Pilling Company, 3451 Walnut Street, Philadelphia, Pa.

Lillian G. Baird
University of Michigan Hospital
Ann Arbor, Mich.

NOTICE

Contributions of notes and case reports to this section will be paid for at the rate of $5.00 per item. Copy and glossy prints for illustrations should be sent to: The Journal, American Association of Nurse Anesthetists, 116 South Michigan Avenue, Chicago 3, Illinois.

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Legislation

Emanuel Hayt, LLB., Counsel, A.A.N.A.

Anesthesia Administration By Nurses In New York State Held Legal By Attorney-General. — Under an opinion rendered by the Attorney-General of New York State on November 15, 1933, it was held that under Sections 1250 and 1262 of the State Education Law, a nurse under the direction of a physician may administer anesthesia. An inquiry was made by the Counsel for the Medical Society of the State of New York on November 10, 1933, as to whether the administration of anesthesia by a nurse anesthetist constitutes a violation of the foreging statute. The Attorney-General stated that the practice of medicine is defined by Section 1250 of the Education Law as follows:

> "Definitions.
> "7. The practice of medicine is defined as follows: A person practices medicine within the meaning of this article, except as hereinafter stated, who holds himself out as being able to diagnose, treat, operate or prescribe for any human disease, pain, injury, deformity or physical condition, and who shall either offer or undertake, by any means or method, to diagnose, treat, operate or prescribe for any human disease, pain, injury, deformity or physical condition.

Section 1262 of the same law provides:

> "Construction of this article.
> "1. This article shall not be construed to affect or prevent the following:
> "(2) the practice of medicine in a legally incorporated hospital by a duly appointed member of the resident staff * * *."

The opinion of the Attorney-General stated as follows:

> "No question arises, therefore, in the case of a nurse anesthetist who is a duly appointed member of the staff of a legally incorporated hospital, such nurse being exempt from the provisions of the article.
> The Education Law does not contain a definition of nursing. According to usage, however, the nurse administers various types of therapeutic treatment under the direction of a physician. The administration of medicines, the application of prescribed treatment, the giving of hypodermic injections and many other duties of importance are among the acts commonly performed by the nurse under the physician's direction. The administration of anesthesia falls within the same category. If done under the direction of a physician, such act on the part of a nurse does not involve a violation of law."

It is to be noted that the opinion of November 15, 1933 states that the Education Law does not contain a definition of the practice of nursing. However, in 1938, an amendment was adopted to the Nurse Practise Act (Sec. 6901, Education Law) which now provides as follows:

> "2. The practice of nursing is defined as follows:
> a. A person practices nursing as a registered professional nurse within the meaning of this article who for compensation or personal profit performs any professional service requiring the application of principles of nursing based on biological, physical and social sciences, such as responsible supervision of a patient requiring skill in observation of symptoms and reactions and the accurate recording of the facts,

> and carrying out of treatments and medications as prescribed by a licensed physician, or by a licensed dentist and the application of such nursing procedures as involves understanding of cause and effect in order to safeguard life and health of a patient and others."

It would seem that the definition of the practice of nursing would not exclude the administration of anesthesia by nurses, but would seem to strengthen the view that such a procedure is valid when performed by a registered professional nurse under the direction of a duly licensed physician.

Hospital Not Liable For Operating Room Explosion Caused By Cautery. — An action to recover damages for personel injuries sustained during the performance of a surgical operation upon a patient was instituted against the hospital. The evidence indicated that the patient's burns were caused by the ignition of gases in the immediate area of the site of the operation, and that these gases were formed by the evaporation of antiseptic which had been applied to the patient's body at and about the immediate site of the operation. The ignition was produced by the surgeon's introduction of the heated cautery into that area.

On appeal, the court reversed the judgment on the law and on the facts, which had been found by the trial court in favor of the patient against the hospital. Commenting on its decision the appellate court stated that the applications of the antiseptic to the patient's body immediately preceding the surgery were part of the operation itself and, therefore, were acts in the nature of treatment of the patient for which acts the hospital is not liable. There was no testimony that anyone saw any stains of antiseptic upon the linen prior to the administration by the physician of the anesthesia which, under the instructions to nurses, would have placed upon them the duty of replacing said linen. With the operation in progress and the patient under anesthesia, it was not the duty of the nurses and anesthetist to interfere with the operation by substituting dry linen for linen which might be wet with some of the antiseptic, except at the direction of the surgeon.

The medical expert of the patient testified that it was the duty of the operating surgeon to see that there were no inflammable gases present in the area in which an electric cautery was to be used by him, and that the direct responsibility for what was done was part of his obligation as head of the "operating team." If he was remiss in that respect, his conduct was in any event a medical omission for which the hospital would not be liable. Although disobedience of an absolute direction to a hospital attaché to carry out a simple manual act, which direction is in pursuance of a medical determination, is an administrative omission for which the hospital would be liable, there was no proof here of the existence of any rule, direction or instruction to these hospital attachés which, in the event the linen became thus contaminated by the antiseptic during the course of surgery, absolutely required any of them to do anything with respect to removing that condition, or to call the surgeon's attention thereto.

Three of the judges concurred in the opinion; two of the other judges dissented and voted to affirm on the ground that the hospital was liable for administrative negligence whether the negligence occurs before, during or after an operation. The dissenting opinion noted that after the patient

had been placed under spinal anesthesia, an inflammable antiseptic was applied to her body in such a way and in such an amount that the linen separating her body from the operating table became contamined therewith. The nurse in attendance testified that the rules of the hospital required, in such an event, that the attachés were to remove the wet linen in order to prevent precisely the type of incident which caused the injuries of which complaint is made. The failure of the hospital attachés to perform this simple manual act, which was part of the hospital directions, constituted administrative negligence for which the hospital may be held liable. The excuse for the failure to remove the contaminated linen i.e., that the nurse in attendance did not see it is insufficient. The nurse admitted that she did not look; had she looked, she would have seen. The failure to see, under these circumstances, does not absolve the hospital from liability.

(I. Bing, res [J. Bing, plf], v. Thunig, def. [St. John's Episcopal Hospital, ap] App. Div.—2nd Dept., N.Y.L.J. March 6, 1956, p. 9)

Operating Room Nurse Held Not Liable For Hemostat Left In Patient By Surgeons. — Plaintiff instituted an action for damages she suffered because during an operation a hemostat, a Kelly clamp six inches long, was left in her abdomen. She joined as defendants the hospital where the operation took place, the surgeon whom she employed to perform the operation, two other physicians who took part in the surgery, the medical anesthetist and the surgical nurse at the operation.

None of the physicians was an employee of the hospital. The hospital provided the operation room, the instruments and the nurse, who was its employee, and charged the patient therefor. The nurse handed the surgeons instruments and sometimes took them back from them but was not asked to apply or remove any clamps and did not do so. The operating room supervisor testified that it is the established practice that at an operation the nurses maintain a sponge and a needle count, but not an instrument count, that nurses are so taught during their training, and that the nurse was not instructed to maintain a count of clamps or other instruments, except needles.

There can be no doubt that the fact that a hemostat was left in plaintiff's abdomen called for the inference that somebody had been negligent. There could only be responsibility of the hospital and the nurse if contrary to the expert evidence as to the established practice they could be held under duty to count instruments used during an operation.

The patient contended that the doctrine of res ipsa loquitur applied to all defendants who had any control over the body of the unconscious plaintiff or the instrument which caused the injury and that they all had the burden of meeting the inference of negligence. Res ipsa loquitur only applies when it is apparent not only that the injury probably was the result of the negligence of someone but also that the defendant is probably the one who is responsible. The cause of the injury clearly pointed to the responsibility of one or more specific defendants, here the surgeons. But at any rate even if it could be said that the surgical nurse as a member of the "team" may have taken part in the actual application and removal of instruments, her possible responsibility in that respect was rebutted by the evidence.

With respect to the hospital and the nurse it is not clear that the res

ipsa inference applies. It cannot be said that common experience indicates that the leaving of a sizable instrument in an abdomen during an operation more probably than not indicates negligence of the surgical nurse, although such is undoubtedly the case as to the operating surgeons.

The only specific basis suggested for responsibility of the nurse, and for the hospital as her employer and as having power to give her instructions, is the fact that she was not instructed by the hospital to take and did not on her own initiative take a count of the instruments. Clearly there is here no room for any inference as to what happened because the facts were conclusively shown by the evidence stated and as to the existence or non-existence of a duty to take such a count res ipsa cannot give any indication. The only question to be decided in this respect is whether the issue of negligence in the failure to take instrument count could be decided by the jury without any expert evidence having been offered in support of the contention of negligence. There was no expert evidence whatever in support of such duty, only evidence to the contrary. As with respect to the hospital and nurse a res ipsa inference had either never been in the case or had been conclusively dispelled and no admissible evidence of negligence was offered; the nonsuit was correctly granted.

1. Leonard v. Watsonville Community Hospital, 291 P. 2d 496 (Calif.)

Book Reviews

THE GIVE AND TAKE IN HOSPITALS. A Study of Human Organization in Hospitals. By Temple Burling, M.D., Edith M. Lentz, Ph.D., and Robert N. Wilson, Ph.D. Cloth. 355 pages. New York: G. P. Putnam's Sons, 1956. $4.75.

Research workers from the New York State School of Industrial and Labor Relations of Cornell University have compiled the results of their study of six hospitals. The project was initiated by the American Hospital Association. The result of this study is a report that should be required reading for all persons in the hospital field. Definitely an example of "as others see us", reading of the book should give each hospital worker a better perspective of his job and a new outlook on his fellow workers. To be most effective, the entire book should be studied but for those anesthetists with limited time, the chapters on *The Nursing Profession* and *The Operating Room* may be of greatest interest. After reading even one of these chapters, the need to know more about the remaining chapters will be apparent.

ANESTHESIA IN OPHTHALMOLOGY. By Walter S. Atkinson, M.D., Associate Clinical Professor of Ophthalmology, New York University Post-Graduate Medical School and the House of the Good Samaritan, Watertown, New York. Cloth. 101 pages, 44 illustrations. Indexed. Springfield, Illinois: Charles C Thomas, 1955. $3.25.

Written by an ophthalmologist, this book is primarily devoted to the presentation of technics of regional anesthesia for eye surgery. Stressing the importance of preanesthetic preparation, several chapters are devoted to psychological, as well as the pharmacological phases of the preoperative period. Relatively brief mention is made of several general anesthetic agents and technics, curare and problems of the airway. A bibliography follows the text.

LOCAL ANALGESIA HEAD AND NECK. By Sir Robert Macintosh, D.M., F.R.C.S. (Edin.), F.F.A.R.C.S., M.D. (hon. causa), Buenos Aires and Aix-Marseilles; Nuffield Professor of Anaesthetics, University of Oxford, and Mary Ostlere, M.B., M.R.C.P.-E., F.F.A.R.C.S., Research Assistant, Nuffield Department of Anaesthetics, University of Oxford. Cloth. 138 pages, 145 illustrations. Edinburgh and London, E. & S. Livingstone, Ltd., 1955. $6.50.

Following the method used in previous books, the authors have presented the subject by an effective combination of drawings and text. With the studied use of color and clear line drawings, the anatomy and the steps in technical procedures are effectively depicted. More than half the text is devoted to anatomical considerations; the second portion of the book outlining specific regional methods. Lists of references follow some chapters. Indexed.

BASIC FACTS OF GENERAL CHEMISTRY. By Stewart M. Brooks, Ph.G., B.S., M.S. Instructor in the Sciences, School of Nursing, Muhlenberg Hospital, Plainfield, New Jersey. Cloth. 354 pages, 77 illustrations. Philadelphia and London: W. B. Saunders Company. 1956. $4.75.

This book has been prepared in a style that presents the subject in a

manner than can be mastered without auxiliary explanation. Written for students such as nurses who are concerned with biologic sciences, the author has directed the applications of chemical tenets to their interests. Because of this, nurse anesthetists will find this a useful book for reviewing and for teaching. The chapters on organic chemistry and on biochemistry will probably be of particular value. Throughout the book, series of questions are presented. Tables, a glossary and a thorough index are included.

SELECTED EXPERIMENTS IN GENERAL CHEMISTRY. By Stewart M. Brooks, Ph.G., B.S., M.S., Instructor in the Sciences, School of Nursing, Muhlenberg Hospital, Plainfield, New Jersey. Paper. 113 pages, 23 illustrations. Philadelphia and London: W. B. Saunders Company, 1956. $2.00.

As in the text to which this manual is a companion, the author uses illustrations that will be meaningful to nurse anesthetists. This manual should be of interest to teachers in schools of anesthesia.

JOINT LIGAMENT RELAXATION TREATED BY FIBRO-OSSEOUS PROLIFERATION. By George Stuart Hackett, M.D., F.A.C.S., Consulting Surgeon, Mercy Hospital, Canton, Ohio. Cloth. 97 pages, illustrated. Springfield, Illinois. Charles C Thomas, Publisher, 1956. $4.75.

The author brings together information concerning the diagnosis and treatment of disabilities of articular ligaments. This book will be of particular interest to anesthetists in that the treatment includes the use of local anesthetics. The technics for injection of various areas are given in some detail.

CLINICAL ANALGETICS. By E. G. Gross, Ph.D., M.D., Professor and Head of Department of Pharmacology, State University of Iowa, College of Medicine, Iowa City, Iowa, and M. J. Schiffrin, Ph.D., Assistant Director of Clinical Research, Hoffman-LaRoche, Inc., Nutley, New Jersey. Cloth. 101 pages. Springfield, Illinois: Charles C Thomas, Publisher, 1955. $3.00

Defining analgetic agents as "those materials which when administered provide relief from pain by means other than reduction or removal of the causative factor," the authors have prepared a concise guide to this large series of agents. The major categories presented are the Salicylates, Paraminophenols and Pyrazolons; opiates, opioids, opiate antagonists and local anesthetics. In addition to factual data, the authors stress the cautious and judicious use of pain relieving drugs. Bibliographic references follow each chapter. Indexed.

Insurance

AN INSURANCE CONTRACT

In this article we shall limit our discussion to the interpretation of an Accident and Sickness policy only. Every Accident and Sickness policy contains two very important clauses or sections. One of these sections is called, "Exceptions or Exclusions". This section must define what the Insurance Company will *not* pay for. The other section is termed "Continuation or Policy Termination". Under the "Exception" provisions the Insurance Company excludes certain sicknesses or accidents. The exclusion clause varies with different insurance companies. This clause also states the age termination or limits on traveling. It is important that you read and understand this clause or section in your Accident and Sickness Policy. Regardless of what the agent or the circulars may imply, the Insurance Company will and must abide by its agreement with the insured. Some exclusion clauses eliminate payments for sicknesses and accidents that the insured is under the impression they are protected against. Remember to read carefully the "Exclusion or Exception" clauses in your policy.

The second section or clause "Policy Termination or Policy Continuation" is as important to the buyer of accident and sickness policies as the "Exclusion" clause. Most Insurance Departments require the Insurance Companies to define on the front of the policy as well as on the first page of the policy, the provisions pertaining to the rights of the policyholder for continuation of the policy. "Cancellable at the option of the Company" or "Renewable at the option of the Company" are to be found in practically every individual policy. This limitation is exactly as it is stated. The Insurance Company reserves the right to either cancel a policy at any time or refuse to accept any further premiums. This provision is used by the Insurance Company in the event of a heavy claim or in anticipation of further losses. Always examine your policy carefully for the termination clauses.

Accident and Sickness Insurance is very much like other casualty insurance. Auto, fire, collision, theft, liability or any other form of casualty is on a year to year basis. The Insurance Company only agrees to accept premiums and offer protection on a term arrangement.

The only protection against an Insurance Company exercising its right to terminate or to restrict payment on certain illnesses or accidents is through a sound group program. The A.A.N.A. has such a plan.

For information on the Professional and Personal Liability as well as any other part of the Program, write direct to National Headquarters.

Report on the Progress of the Insurance Plan

The Insurance Program is constantly gathering momentum throughout the various states. Of particular interest is the increasing interest in the Accident and Sickness Plan. Perhaps this is due to the number of claims being paid to the members in the various states and as the old saying goes, "The proof of the pudding is in the eating."

The leading states in participation in the Insurance Program are: California first, Illinois second, Michigan third, Minnesota fourth, Pennsylvania fifth. Some of the other states are so close to Pennsylvania that by the next issue of The Journal the positions may change.

The tear-out, free postage information card used in the last issue of The Bulletin has met with such success that it has been decided to use the same idea for future enrollments in the Liability and Retirement Plans.

Under the Professional and Personal Liability Program, the enrollment is way over the thousand mark already. This is an actual amount of policies issued and many, many hundreds more are being issued at this time. The great majority of the members enrolling have selected Plan III, or the maximum amount of protection under the Professional and Personal Liability.

We have had the pleasure of answering many hundreds of inquiries regarding insurance. As Insurance Consultants for the A.A.N.A. please feel free to write at any time for advice or counsel regarding any insurance problem. We will, from time to time, offer further explanations on various types of policies offered the members.

Write direct to A.A.N.A. Headquarters, 116 South Michigan Avenue, Chicago, Illinois, for full particulars about your Group Accident and Sickness Plan.

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Insurance Consultant
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For the convenience of those of you who will be in Chicago attending the annual meeting, we will have a suite in your convention headquarters hotel. My staff and I will be happy to arrange to discuss your A.A.N.A. Financial Security Program with you. Call my suite at the Congress Hotel for a specific appointment.

John Maginnis

Classified Advertisements

WANTED: Nurse anesthetist for 240 bed hospital 20 miles from Pittsburgh, Pa. Unusual work day opportunity to work every third day (24 hours at hospital, then 48 hours off) starting September 1. Salary $4680. All types of surgery except neurosurgery. Apply with references to: S. L. Carpenter, M.D., Chief, Anesthesiology, Allegheny Valley Hospital, Tarentum, Pa.

NURSE ANESTHETIST. 500-bed general hospital doing obstetrical and surgical anesthesia; 250 plus deliveries monthly. $425-$450 per month, complete maintenance if desired. Apply: Akron General Hospital, Akron, Ohio.

NURSE ANESTHETIST. Attractive opportunities. Rotate in surgery and obstetrics. Outstanding financial program; paid vacation, sick leave, periodical raises and hospital insurance. Group anesthesiologist supervision. 250 bed fully approved general hospital expanding to 500 beds. Apply: Administrator, Baptist Hospital, Nashville, Tenn.

NURSE ANESTHETIST, Registered. 185 bed approved hospital. $450 starting salary, 40 hour week, 3 weeks vacation, sick leave benefits and merit increases. Write: Personnel Office, Blessing Hospital, Quincy, Ill.

NURSE ANESTHETIST. For 300 bed hospital, Western Pennsylvania. Starting salary $400 for experienced nurse anesthetist with minimum of two $25.00 yearly increases. Extra remuneration for on call. 40 hours. Write details of training and experience to Administrator, Butler County Memorial Hospital, Butler, Pa.

NURSE ANESTHETIST. New and modern surgery; unusually strong and well diversified surgical staff. Good opportunity in new 200-bed expanding hospital; college town location; good personnel policies; 40 hour week; 7 holidays, hospitalization, social security. Apply: F. J. O'Brien, Administrator, Chambersburg Hospital, Chambersburg, Pa.

ANESTHETISTS: Charleroi-Monessen Hospital (general, 238 beds and 36 bassinets), North Charleroi, Pa. (HU 3-5561). Salary open plus maintenance, sick leave, holidays, month paid vacation annually, etc. Call or write administrator.

NURSE ANESTHETIST: 250 bed general hospital; excellent working conditions and personnel policies. Write: Mr. Bert Stajich, Assistant Administrator, Columbia Hospital, 3321 N. Maryland Avenue, Milwaukee 11, Wisconsin.

REGISTERED NURSE ANESTHETIST for modern air conditioned hospital, North Side, Chicago; fully accredited; 12 modern operating rooms; salary open for discussion. Free meals and uniforms, Social Security, paid vacation and paid sick leave. Write Box W-10, Journal American Association of Nurse Anesthetists, 116 S. Michigan Ave., Chicago 3, Ill.

NURSE ANESTHETIST: 600 bed approved general hospital; excellent salary, one month vacation after a year's service. Apply, Personnel Director, Good Samaritan Hospital, Cincinnati 20, Ohio.

WANTED IMMEDIATELY: NURSE ANESTHETISTS for 700 bed general hospital. Pleasant working conditions. Salary open. Complete maintenance; liberal employee benefits. Apply to: Personnel Director, Grady Memorial Hospital, Atlanta, Ga.

NURSE ANESTHETIST wanted for 200-bed general hospital in rapidly growing community. Salary open, maintenance furnished, also other fringe benefits. Hospital fully approved. Now has four full time nurse anesthetists, seeking one more to fill out the staff. Excellent surroundings. Apply: Administrator, Thomas Memorial Hospital, South Charleston, W. Va.

ANESTHETIST. Immediate opening, 200 bed hospital. Salary open. Contact: Administrator, John Peter Smith Hospital, Fort Worth, Texas.

WANTED—Nurse Anesthetist to complete staff of five. College city, 60,000 population, oil center, modern hospital, approximately 500 beds, new operating room suite, rotate surgery call every 5th night and 5th weekend, no OB call. Starting salary $400, room and board available. Contact: O. P. Daly, M.D., Supt., Lafayette Charity Hospital, Lafayette, La.

NURSE ANESTHETIST. 100 bed general hospital, Southeastern Massachusetts, near Cape Cod and other resort areas, to work with Anesthesiologist. Salary, etc., open depending on training and experience. William H. Lewis, M.D., 376 Tremont St., Taunton, Mass.

NURSE ANESTHETIST. Excellent salary and working conditions. Shore resort community. Send resume of experience and background to Personnel Office, Lawrence and Memorial Associated Hospitals, New London, Conn.

NURSE ANESTHETISTS (2): Permanent position in general hospital. Salary dependent on experience. Month vacation with pay after one year of employment; two weeks sick leave, ten paid holidays. Rotating nights, no O.B.-S. call. Apply: Alyce J. Benn, Chief Nurse Anesthetist, Massachusetts General Hospital, Fruit Street, Boston 14, Mass.

NURSE ANESTHETISTS—400 bed hospital, staff of five nurse anesthetists and one anesthesiologist. Salary up to $400 a month and other benefits. For particulars contact Vincent A. Kehm, M.D., Chief of Anesthesia, York Hospital, York, Pa.

WANTED: Nurse Anesthetist for 800 bed teaching hospital. Staff of 6 Anesthesiologists, 1 Fellow, 4 Residents, and 9 Nurse Anesthetists. Salary range $4,920 to $6,144 annually with merit rating increases, one month paid vacation, 15 days sick leave annually which can accumulate to 90 days; only emergency operations on Saturdays and Sundays. Please reply to: Mrs. Geneva R. Watkins, Head Nurse Anesthetist, Anesthesia Dept., Medical College of Virginia, Richmond 19, Virginia. State age, qualifications, and school of anesthesia.

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WANTED—NURSE ANESTHETIST for employment in 200 bed accredited hospital in central Pennsylvania. Industrial and farming area. Modern hospital. Department staffed by 4 nurse anesthetists and certified M.D. Write: Administrator, Lewistown Hospital, Lewistown, Pa.

WANTED: A nurse anesthetist for my oral surgery clinic. Steady employment on salary basis. Must be immediately available. Willingness to work and learn more essential than a high degree of proficiency in anesthesiology. Wire or write: Oral Surgery Clinic, Prunty Building, Clarksburg, W. Va.

NURSE ANESTHETIST: 180 bed general hospital in Hilo, Hawaii. Averaging 100 majors and 100 minors monthly. Four anesthetists on staff. Civil Service, salary $383, increases yearly to $445. For full particulars write Superintendent, Puumaile & Hilo Memorial Hospital, Hilo, Hawaii.

NURSE ANESTHETIST: Starting salary $405 per month for AANA members; $375 per month if eligible for membership. Annual increases plus laundry and private room with bath and telephone in new women's residence. Social Security and Pension Plan. 40 hour week including full time credit for first call. Second call paid for cases done. Six paid holidays, 30 days vacation annually and liberal sick leave policy. Apply: Marshall Kerry, M.D., Chief, Anesthesiology, The Reading Hospital, Reading, Pa.

ANESTHETISTS: Vacancy for one or two to complete team. Anesthesiologists available. Good salary, fringe benefits, full maintenance if desired. Write or call: Chief Nurse Anesthetist, Rex Hospital, Raleigh, N. C.

NURSE ANESTHETIST wanted for 175 bed approved general hospital located in surburban Philadelphia. Write: Box 7168, Philadelphia 17, Pa.

POSITION WANTED: Registered Nurse Anesthetist with 3 years experience. Will be discharged from military service in August; will be available late September. Desire position in location of Philadelphia or surrounding area. Prefer to work with anesthesiologist. Will rotate O.B. call if necessary. Interested in pediatric anesthesia. Salary open. As of the middle of August my permanent address will be: Miss Marie T. Spinelli, Decatur and Red Lion Roads, Philadelphia 14, Pa.

WANTED: Beginning September 1, 1956, two nurse anesthetists, modern well equipped general hospital, 75 beds, 25 bassinets. Town of 6,000, 50 miles from Philadelphia or Baltimore. Approximately 100 operations and 60 deliveries per month. Alternate nights and week-ends. $450 per month and full maintenance. Apply or write for interview: Chief of Surgery, Union Hospital, Elkton, Md.

ANESTHETISTS for 155-bed modern general hospital; excellent year round recreational area; air conditioned work areas; good personnel program; remuneration $5,000-$6,500. Call or write Administrator, Midland Hospital, Midland, Michigan.

NURSE ANESTHETIST: Modern 63 bed hospital located in the Shenandoah Valley of Virginia. Good salary and working conditions. Apply: Administrator, Stonewall Jackson Hospital, Lexington, Virginia.

NURSE ANESTHETIST: 100 bed, two year old, modern, general hospital located in resort town. Excellent employee benefits. Apply: Administrator, Mercy Hospital, Port Huron, Mich.

THREE NURSE ANESTHETISTS to complete team of eight under two anesthesiologists in center of Boston's cultural and recreational facilities. Good salary without maintenance. Quarters available at minimum cost. Light call duty once weekly and rotation on weekends with extra pay. Write: Anesthesiologist, Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston 14, Mass.

ANESTHETIST for position in 134 bed general hospital — salary, living conditions, etc., very desirable. Salary open and includes board, room, laundry and insurance benefits. Location on East Side of St. Paul, bus service convenient to all areas. Minimum amount of call. Two other anesthetists on duty. Write: E. M. Garnett, R.N., Administrator, Mounds Park Hospital, 200 Earl St., St. Paul 6, Minn.

NURSE ANESTHETIST to work in municipal hospital. Qualifications: Graduation from a recognized school of nursing supplemented by completion of an accredited course in anesthesia. Possession of a license or eligibility to obtain license as Registered Nurse in the State of Connecticut. Salary Range $3692-$4108 per annum. Complete details by writing to Director of Personnel, Municipal Building, Hartford, Conn.

WANTED: NURSE ANESTHETIST, rural hospital Southwest; F.A.-C.S. Surgeon, rare night call, open salary, excellent place to raise children, and be a part of a congenial small group. Give all details and salary expected in letter. Address Box W-12, Journal of the American Association of Nurse Anesthetists, 116 S. Michigan Ave., Chicago 3, Illinois.

ATTENTION CONVENTIONEERS

To those of you who will attend the Jubilee Meeting, we are trying a new system which will save you time during the first days of the convention. To avoid the long waiting line for the purchase of tickets, you may BUY YOUR BANQUET TICKETS BY MAIL NOW.

Single tickets will not be sold by mail; however, since most of you will want to attend both banquets, the gala Monday Night affair and the 25th Jubilee Banquet on Wednesday, you may purchase both for $11.00.

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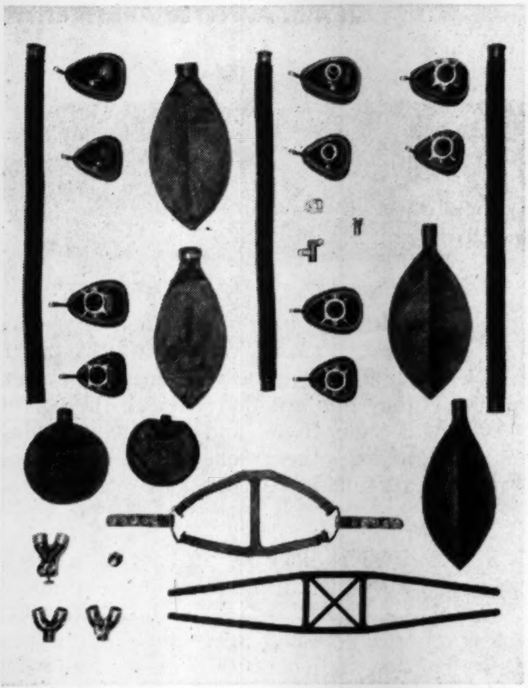
Enclosed is my check for $________for_____sets of tickets. This advance sale will be discontinued on September 8.



Abstracts

Potts, W. J.: The heart of a child. J.A.M.A. 161:487-490 (June 9) 1956.

"The physical heart of a child is just a piece of living muscle marvelously adapted to its sole function of pumping blood. It is a rugged mechanism that will tolerate the ravages of infection, the scars resulting from impaired blood supply, and the approaches of surgeons' tools. It is the most efficient self-sustaining pump in the world. In a philosophical sense, the heart of a child is a delicate mechanism, sensitive to the slightest wounds of fear insecurity, indifference, thoughtlessness, and misunderstanding. Many centuries before its physical function was known, the heart was considered the seat of all emotions and impulses, good and bad. From earliest infancy the heart of a child is subject to a constant stream of mental and physical stimuli, but for the purpose of this discourse it reflects the results of stimuli with which it is bombarded during those short phases of life when the infant or child suddenly meets head-on with doctors, illness, hospitalization, and operation .... Little children are afraid of doctors because of previous unpleasant procedures to which they have been subjected. They employ no system of logic in evaluating the virtues of medical or surgical treatment. Primarily they fear needles and 'shots.' .... It is a truism worthy of repetition that a doctor's successful approach to a child is based on a fundamental love of children and a cultivated tolerance of their eccentricities .... Many of the 'badly behaved' children become very amenable when they find out that after all the doctor is their friend and is actually trying to help them. The child reflects the attitude of its parents ....

"The doctor's primary concern is with the effect upon the emotions of the infant or child whose illness is severe enough to require hospitalization and operation. I have often wondered what sort of a scar, how deep and how serious, is left on the heart of a child who is torn from its parents and suddenly tossed into hospital environment associated in its mind with insecurity and pain .... Children's hospitals are marvelous institutions to parents the day they take home their child who was ill and now is well. That does not change the fact that to a child a hospital experience is often a nightmare. Before the age of reason, a child is unable to comprehend why he should have been subjected to the emotional insecurity of separation from his mother. Even the finest hospital falls far short of what an ideal hospital should be. If nursing service were limitless, and if laws of economics could be repealed, there would be no problem .... Of necessity, hospital care for children has become extremely complicated and, consequently, has a tendency to become too impersonal .... When dealing with immature and uncomprehending minds, parents and doctors have to do

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the best they can to minimize the rips and tears in the emotional patterns of the children. Little is known about the memory of a child during its first year of life, but it is known that reactions to fear and insecurity manifest themselves early. An infant up to about one year of age is indifferent to physical surroundings but not by any means indifferent to the people who care for him. Ordinarily, it is believed that the infant aged 6 months or less does not care whether the mother is present. Actually, the infant does not care, so long as a substitute mother gives the same tender loving care. Nurses act as substitute mothers . . . . The child needs protection and love given by instinct, uninhibited by theoretical advisors and professional baby raisers . . . .

"Infants require stimulation—auditory, visual, and tactile. Their development—entirely by the route of their senses—must continue during those periods of time that are spent in a hospital. Of course, an illness of a week or two is going to leave no scar. The child's memory of pain is short, and the ability to harbor resentment has not yet developed. Prolonged illness is another story. It has been shown again and again by psychiatrists that infants do poorly in a foundling home where they get a minimum of attention. Even under the most hygienic surroundings, they develop poorly physically and mentally. The mortality rate is higher in these children than it is in even a rather poor home where they get essential tender loving care . . . . There is no place in the world like home for a child. Even the poorest home, where there is accord, is better than the finest hospital. If the child must remain in the hospital long, visit often and crowd in as much attention as possible during those few hours. Whatever spoiling may be done during visiting hours will be counteracted during the rest of the day and night. The child will naturally cry when the parent leaves, but return visits will dispel the fear of being forgotten or deserted . . . . At Children's Memorial Hospital the child is told exactly what is going to happen . . . . Children are such amazing little creatures. Tell them in simple words why they have to go to the doctor or the hospital or why they have to have an operation and, in most instances, they will cooperate in a fashion that adults might well emulate. Faith and Trust are completely unspoiled when children are dealt with honestly. So little effort; so great the reward . . . .

"The mystical heart of a child is a precious and beautiful thing. It is marred only by wounds of a thoughtless and not too intelligent world. In a physical sense the heart is a tough organ; a marvelous mechanism that, mostly without repairs, will give valiant pumping service up to a hundred years. In an emotional sense it is susceptible to wounds of indifference, thoughtlessness, and neglect and during episodes of illness is especially vulnerable. The heart of a child is mysteriously moulded by parents, teachers, playmates, and all those with whom it comes in contact. Physicians wish during those short but violent episodes of illness to avoid wounds that will leave irreparable scars. I am convinced that the heart of a child sunned by love, security, and understanding will be able to withstand the storms of illness and pain."

Clinical anesthesia conference: Carotid sinus syndrome. New York State J. Med. 56:729-730 (March 1) 1956.

"This report concerns the differential diagnosis of carotid sinus syndrome occurring during the course of major neck surgery .... An eighty-two-year-old male was prepared for excision of a mixed cell tumor of the right parotid gland and extensive neck dissection .... Anesthesia was administered with cyclopropane-oxygen by the oral endotracheal route. Induction was smooth and relatively rapid; after cocainization of the pharynx and larynx to minimize vagal reflexes, intubation was performed adeptly. Blood pressure prior to induction of anesthesia was 90/100 with pulse of 88. This level prevailed at the time of incision. Approximately twenty minutes after operation had begun, there was a moderate amount of bleeding; simultaneously there was a precipitous fall in systolic and diastolic pressures to 98/56. The pulse and respiration did not change in character or rate. Since the surgical incision had extended into the anterolateral triangle of the neck, the diagnosis of carotid sinus syndrome of the depressor type was suspected. To corroborate this, 0.8 mg. of atropine was injected intravenously without a significant change in pulse rate or blood pressure. This was expected with the reflex primarily of the depressor type. Consequently 25 mg. of ephedrine were slowly injected intravenously. Within five minutes the blood pressure rose from 100/76 to 180/90. The pulse, meanwhile, remained at about 88 beats per minute. Surgery progressed for an additional forty-five minutes, at which time the carotid sheath and artery were widely exposed. Because the systolic pressure again began to fall, the carotid bulb was infiltrated with 1 per cent Pontocaine. This was followed by a return of the blood pressure to 180/100, and it remained at this level throughout the next two and one-half hours of operation. Fluid therapy consisted of 500 cc. of blood and 500 cc. of 5 per cent dextrose in water. The postoperative course was smooth ....

"Three types of carotid sinus syndrome are recognized: 1. The vagal type is characterized by cardiac slowing or asystole, hypotension, and cerebral hypoxia. This type of reflex is potentiated by digitalization and parasympathomimetic drugs and abolished by atropine. 2. The second type is represented by the case cited in this report. It is characterized by a fall in blood pressure without significant change in pulse. It is accented by the nitrites and counteracted by epinephrine or ephedrine. 3. The third or cerebral type does not lend itself to diagnosis during anesthesia since the patient is already unconscious. However, cases showing both bradycardia and hypotension have been considered to be partly of the cerebral type. The cerebral type is not influenced by atropine or epinephrine but responds to local anesthetic infiltration of the carotid bulb."

Papper, E. M.: Renal function during general anesthesia. Bull. New York Acad. Med. 31:446-452 (June) 1955.

"Most of the information on kidney function has been obtained in connection with its role as a circulatory organ and its effects on the excretion of water and electrolytes. Much less information is available on the influence of acidosis or anoxia during anesthesia and even less is known about the mechanisms which produce the kidney changes that have been defined .... It appears from the information available that anesthetic agents that produce loss of conscious-

ness have a profound, more or less uniform, and nonspecific effect upon renal hemodynamics and urine formation. The hemodynamic changes that are observed in the kidney are those of intense intrarenal vasoconstriction which persists no longer than the period of unconsciousness. The arteriolar constriction appears to be both afferent and efferent as evidenced by reduction in both glomerular filtration and renal plasma flow. The magnitude of reduction in blood flow through the kidney is great and when taken together with the simultaneous reduction in flow through the splanchnic circulation it is evident that there is a reduction in peripheral blood flow through these two major organ systems of approximately 50 per cent. There must, therefore, be a considerable redistribution of blood flow during anesthesia .... It does not appear that these changes, i.e., renal vasoconstriction, reduced glomerular filtration, and water and electrolyte retention are meditated through the autonomic nervous system .... It is unlikely that the effects upon renal function during general anesthesia are directly due to a drug effect since they are rapidly reversible after the termination of anesthesia during the period when the concentrations of the anesthetic agents in body tissues could not have been altered significantly. It is most striking and perhaps of great importance that the hemodynamic changes observed during general anesthesia in the kidney resemble those seen during shock, congestive heart failure, severe pain, chronic anemia, severe exercise, or sudden change in posture. These situations, including general anesthesia, possibly have in common the fact that visceral vasoconstriction serves the purpose of diverting blood temporarily from organs where it is not immediately needed to other areas of the body such as the heart and the brain that are quite sensitive to oxygen deficits ....

"It is possible that the hemodynamic changes are due to an humoral agent which appears quickly in the circulating blood after the establishment of general anesthesia and clears as rapidly on recovery .... The disturbances in urine formation and electrolyte secretion can be attributed only in part to the release of antidiuretic hormone by the posterior pituitary gland. The diminution in electrolyte excretion during general anesthesia is significant and is not accounted for by diminution in plasma concentration of sodium, potassium or chloride. It is more likely that the fall in glomerular filtration resulting from intrarenal vasoconstriction permits a relative increase in the tubular reabsorption of both electrolytes and water. General anesthetic agents do not account for the failure of the kidneys to make appropriate adjustments in the immediate postoperative period since these functions have been returned to normal prior to this period. It is possible, however, that the tubules have been conditioned in some way by anesthesia and operation so that excretion of water and salt loads in subsequent days is inefficient. Possibly over-secretion of adrenal cortical hormones and cellular changes in renal tubules consequent to prolonged vasoconstriction may have some part in this problem .... A possible explanation of the changes occurring in electrolyte excretion, particularly of sodium, is concerned with the effects of peripheral venous congestion .... The striking renal dysfunction which may occur in the postoperative period is not due to the influence of the anesthetic agent but presumably to other factors involving the responses to stimuli from the

operative area with subsequent shifts in body fluids."

Atkinson, W. S.: Anesthesia for glaucoma surgery. New York State J. Med. 56:205-213 (Jan. 15) 1956.

"It is well known that strict attention to the details of preanesthetic preparation is essential in order to obtain good anesthesia and akinesia for intraocular surgery. This is particularly true when preparing a patient with glaucoma for operation. When an operation is indicated for a patient with glaucoma, it may be advisable to postpone discussing it with the patient until satisfactory sedation and miosis have been obtained, in order to avoid a sharp rise of tension. For patients with painful, acute, congestive, narrow angle glaucoma with high tension, a retrobulbar injection of procaine hydrochloride (Novocain) or lidocaine hydrochloride (Xylocaine) with epinephrine hydrochloride and hyaluronidase, followed by pressure over the eye for at least five minutes, will stop the pain and usually lower the tension. Diamox (acetazoleamide) may be given to help lower the tension as soon as the patient is able to retain oral medication, or it may be given intravenously when the patient is nauseated .... For preanesthetic sedation pentobarbital sodium ... or secobarbital sodium ... given one and one-half hours before operation, is advocated unless it is contraindicated, in which case a suppository of chloral hydrate 1 to 2 Gm. is used. Meperidine hydrochloride ... by intramuscular injection is given at the same time as a matter of convenience .... At the same time chlorpromazine hydrochloride ... may be given along with the Demerol to try to decrease the incidence of nausea and vomiting ....

"For topical anesthesia tetracaine hydrochloride (Pontocaine) 1 per cent is my preference, and at least four instillations at three-minute intervals are made. Epinephrine is usually contraindicated for most glaucoma operations because of the rapid mydriasis that is causes even after strong miotics have been used .... For injections to produce anesthesia and akinesia, either procaine hydrochloride (Novocain) 2 per cent or lidocaine hydrochloride (Xylocaine) 2 per cent may be used .... For injections to produce akinesia of the orbicularis and retrobulbar injections, six to ten turbidity-reducing units of hyaluronidase are added to each cubic centimeter of the anesthetic solution to produce greater diffusion of the anesthetic solution. Epinephrine hydrochloride 1:50,000 is added to the anesthetic solution for these injections unless contraindicated .... For the trephine operation the following anesthetic procedure has been found to be satisfactory: Instillations of tetracaine hydrochloride (Pontocaine) 1 per cent solution, akinesia of the orbicularis, and an injection of lidocaine hydrochloride along the superior rectus muscle so that a bridle suture can be introduced without causing pain .... For operations such as iridectomy, iridencleisis, diathermy, and enucleation a retrobulbar injection is essential to produce more complete anesthesia of the globe, anesthesia and akinesia of the extraocular muscles, and hypotony .... Pressure over the eye combined with moving it in the orbit for at least five minutes to produce better anesthesia and to increase hypotony is of sufficient importance to warrant repetition .... When the eye is red and inflamed, as in cases of acute or absolute glaucoma, a subconjunctival injection should also be given."

Adrenalectomy

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for adrenalectomies: (1) preparation of patient with reassurance and adequate sedation; (2) smooth induction and light plane of anesthesia are essential; (3) keep patient well oxygenated, thus avoiding anoxia; (4) careful check and support of blood pressure with Levophed or hydrocortisone intravenously; (5) most critical period during procedure is immediately following removal of second adrenal at which time severe hypotension may develop; and (6) anesthesia is usually well tolerated by these patients.

References

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3. Huggins, Charles and Thomas, L-Y Dao: "Adrenalectomy and Oophorectomy in Treatment of Advanced Carcinoma of the Breast." J.A.M.A. **151**:1394, 1953.
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Hypotension

(Continued from page 183)

remember, also, that the patient's head should be in the Trendelenburg position to promote, by gravity, better cerebral circulation.

The complications following the hypotensive state are numerous. The most frequent one is slow recovery from the postanesthetic depression. Secondly, reactionary hemorrhage from bleeding points that were not detected and tied off may resume bleeding when the blood pressure rises. Anuria, coronary thrombosis, pulmonary embolus and cerebral thrombosis are occasional complications.

The decision to use controlled induced hypotension lies with the surgeon. This is not an anesthetic procedure, but since it may be an essential one, the anesthetist is called upon to direct its management.

Summary

1. Too much emphasis cannot be placed on the importance of an accurate estimation of blood loss and its replacement.

2. Although the depth of anesthesia during the controlled hypotensive state is not as great, the need for adequate pulmonary ventilation is greatly increased.

3. The quality and rate of the peripheral pulse will serve as an excellent guide as to how the patient is tolerating the hypotensive state.

4. It is suggested that two anesthetists be present to carry out the Arfonad technique: One to manage the anesthesia while the other checks the blood pressure and regulates the intravenous drip.

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